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VICTORIA.

THE

YEAR BOOK OF AGRICULTURE
FOR 1905.

BY

THE STAFF OF THE DEPARTMENT.

By Authority:
ROBT. S. BRAIN, GOVERNMENT PRINTER, MELBOURNE.

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PREFACE.

In republishing articles from the Journal in what I trust will be the first of a permanent series of Year-Books of Agriculture, I feel that an attempt should be made to meet the special claims which the younger generation of farmers have upon the State. The former opportunities of easily obtaining tracts of rich land have passed away, the competition of other States is more keenly felt, and our staple products have to enter the open markets of the world. Every fact, therefore, which helps to increase the efficiency of agriculture under our new conditions is of value, and a handbook such as this is required to assist in securing the success of the Closer Settlement Acts. But there is another and perhaps a more important object that we have in view. No books dealing with agriculture are to be found in many of the more remote farms and stations. Boys and girls are growing up with no opportunity of obtaining information concerning the things they are handling and thinking about every day, and which will form their future life work. It is hoped that the Year-Book will assist not only the material, but also the intellectual development of Victoria.

I have to thank the officers of the Department and other contributors to this volume, among whom I would specially mention the Hon. J. L. Dow, for the chapter on Wheat, and Mr. Jas. Cameron, M.L.A., for that on Maize. The illustrations for the most part are taken from the *Journal* and other publications of the Department, and are original with the exception of five in Chapter XII. (from "American Vines," by MM. Viala and Ravaz), and of seven in Chapter XIV. (from the Report of the Indian Horse Commission).

GEO. SWINBURNE,
Minister of Agriculture.

December 26th, 1905.

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CONTENTS.

CHAPTER I.

INTRODUCTION.—AGRICULTURAL HIGH SCHOOLS.

The Director of Agriculture.

Animal Husbandry the Highest Branch of Agriculture ... 24
Agricultural Education in Europe ... 20
Animals, Numbers of Farm ... 18
Areas of Agricultural Holdings ... 17
Areas under Cultivation ... 17
Change of Agricultural Methods in Denmark ... 25
Continuation Work from State Schools 24
Crops going out of Cultivation ... 18
Dairying, Progress of ... 18
Denmark, Education in ... 21
  Results of Education in ... 25
Education, Agricultural ... 20
Educational Work of Department ... 20
Experimental Fields ... 19
Export Trade, Progress of ... 19
Farm Attached to Agricultural High School ... 26
  to be used for Experimental Work ... 26
France, Farmers' Schools ... 21
Harvey, L. D., on Agricultural Education ... 22
High School, Equipment and Cost of ... 27
Ireland, Agriculture in National Schools 21
Lambs, Export of ... 19
Mortimer, J., on Agricultural Education 21
Number of Agricultural Holdings ... 17
Oats, Yields of Different Varieties ... 18
Organization of Agricultural High School ... 26
Percentage of Land Cultivated ... 17
Phosphoric Acid, Effects of, 1905 ... 17
Potatoes, Experiments with ... 18
Proposals for Establishing High Schools 28
Storing Wheat, Extent of Losses in ... 23
Subjects to be Taught at Agricultural High Schools ... 25
Swine Fever in Denmark ... 25
Tuberculosis in Denmark ... 25
Victoria, Special Educational Requirements ... 23
Waste Lands, Experiments with ... 20
Wheat, Area under Cultivation ... 17
  Yields of Different Varieties ... 18

CHAPTER II.

THE SOILS OF VICTORIA.

T. Cherry, M.D., M.S.

Alluvial Soil, Characteristics of ... 38
Analyses, Average Results of ... 36
Analyses of Coastal Soils ... 33
  Drained Swamp Soils ... 35
  Hill Soils ... 31
  Mallee Soils ... 35 36
  Northern Soils ... 32
  Typical English Soils ... 36
  Volcanic Soils ... 34
  Werribee Soils ... 35
Animals and Forests, Corelation of ... 44
  Concentrate Phosphoric Acid on the Surface ... 42
  Essential to Increase the Fertility of the Land ... 42
Arid Soils tend to Remain Fertile 29 36
Average Production of Victorian Farms 43
Australia, Absence of Large Animals in 42
Buckshot Soils, Characters of ... 41
Character of Soil Dependent on Rocks ... 29
Chemical Results Compared with Crop Yields ... 43
Chocolate Soils, Characters of ... 41
Clay Soils, Readily Improved by Cultivation ... 37
  Water-holding Capacity of ... 37
Coastal Plain ... 30
  Soils, Composition of ... 33
  Characteristics of ... 38
Drainage Necessary in Clay Soils ... 37
Drained Swamp Soils, Composition of ... 35
English Soils, Average Composition of ... 36
Estimating the Fertility of the Soil ... 29
Fertility of Soil, Causes Influencing ... 29
Forests, Influence on Soil ... 44
Gippsland and Cape Otway Soils ... 37
Hill Country, Description of ... 29
  Soils, Composition of ... 31
  Soils, Peculiarities of ... 36
  Subsoil, Value of ... 37
Humus, Value of, in North ... 40
Lime, Plentiful in North-West ... 39
Mallee, The ... 30
  Soils, Composition of ... 35 36
Mildura, Density of Population at ... 43
Mixture of Ingredients of Soil ... 39
Nature's Method of Increasing Soil Fertility ... 42 43
Northern Plain ... 30
  Soils, Composition of ... 32
  Characteristics of ... 39
Older Volcanic Soils in Victoria ... 41
Physical Features of Victoria ... 29
Phosphoric Acid, Deficiency of ... 42
Plant Food, Amount of, in Victorian Soils ... 43
Plains, Scorched, Character of ... 39
Rainfall Controls Fertility of Northern Soils ... 40
  Influence of, on Volcanic Soils ... 41
Sandy Soils, Characteristics of ... 38
  Typical Distribution of ... 38
Scorched Plains, Character of ... 39
Sheep, Improvement in Hills due to ... 42
Subsoil, Clay, Rich in Phosphoric Acid 37
Swamp Lands Rich in Nitrogen ... 39
Volcanic Region, Description of ... 30
  Soils, Composition of ... 34
  Characters of ... 40
  Effect of Wind on ... 40
Werribee Land Improves under Cultivation ... 43
  Soils, Composition of ... 35
Weight of Soil to Acre ... 31
Wheat, Average Yields of ... 42

CHAPTER III.

CLOSER SETTLEMENT STUDIES.

R. T. ARCHER, P. J. CARROLL, T. CHERRY.

Amber Cane for Fodder 49
Barley and Peas for Fodder 48
Bacteria, Influence of on Soil 46
Bendigo, Irrigated Farm at 58
Bracken Fern for Bedding 51
Breaking up the Land 59
Brighton, Character of Soil at 45
Butter-fat Value of Milk 57
Caulfield, Character of Land at 45
Clay Subsoil, Value of 52
Clovers to be Largely Sown 50
  Why they are Important 50
Cost of Artificial Fertilizers 62
Cultivation to Conserve Moisture ... 49
Dairy Farms, small ... 53 56 57 58
Drainage, Importance of 47
  Makes the Land Early 48
  Results of at Yarragon 54
Farm Returns from 25 acres 61
  46 acres 55
  80 acres 56
Farmyard Manure 45 49
  Management of 51 59
  Amount from Cows 60
  Value of per ton 60
Fodder Crops for Winter 48
Grasses, Mixtures to Sow 50 63
Horse Beans for Fodder 48
Irrigation at Bendigo 59
Japanese Millet 49
Lime for Sour Land 48
Live Stock Essential to Small Farms 46
Lucerne for Cows 57
Maize as Fodder Crop 49
  at Bendigo 59
  at Trafalgar 54 56
  at Yarragon 56
Milk, from 14 Cows 55
  from 30 Cows 56 61
  Individual Cows 56
  Shorthorns 57
Nagambie, Shorthorns at 57
Oat Crop, Cultivation of 47
  Manures for 47
Pasture in Rotation System 50
Peas for Fodder 48
Plant Food in Soil 46
  Amount Required 62
Planting in Drills 49
Ringwood, Development at 52
Roots, depth of, in Soil 52
Root Crops 49 54
Rotation System 46 51
Rye Grass and Cocksfoot 50
Second Year's Rotation 48
Silage at Trafalgar 56
  Yarragon 54
Subsoiling for Maize 48
Summer Crops Without Irrigation ... 49
Tares for Fodder 48
Tick or Horse Beans for Fodder ... 48
Trafalgar, Farm at 56
Water, Amount used for Irrigation ... 60
  Cost of at Mildura 62
  Method of Applying 61
Yarragon, Dairy Farm at 53
  Cash Returns from 55

CHAPTER IV.

A FARM PEST.—ST. JOHN'S WORT.

C. FRENCH, F.L.S.

Area Affected 65
Arsenite of Soda for 67
Bethanga Pyrites for 67
Botanical Description 64
Cutting to Exterminate 71
Distribution in Victoria 64
Dodder Arrests the Weed 72
Eradication, Cost of 66 69
  Experiments 66 69
Globe Weed Killer for 64
History of in Victoria 64
Invicta for 67
Murton's Sheep Dip for 68
  Weed Killer for 68
Murchison's Scrub Exterminator ... 69
Ploughing to Kill 71
Preparation of Materials 70
Salt for 69 72
Seeds Spread by Chaff, &c. 72
Silex for 69
Spread of, to Prevent 71
Sulphuric Acid for 69

CHAPTER V.

IRRIGATION ON THE FARM.

A. S. KENYON, C.E.

Area Supplied by State Works 73
Bacchus Marsh, Irrigation at 87
Bendigo, Amount of Water Used ... 74
  Results at 74
  Flora Hill Farm 74
Channels, Capacity of 86
Construction of Doncaster Dams ... 78 84
Cultivation Necessary to Irrigation ... 75
Dams, Construction of 83
Distribution of Water 81
Doncaster, Amount of Water Used ... 74
  Description of 75
Drainage Necessary 75
Grading and Preparation of Land ... 86
Gully Dams 79
Hill-side Dams 77 80 85
Hill-top Dams 80
Irrigation Memoranda 88

CHAPTER V.—*continued.*

Limitations of Cultivation Without Irrigation ... 74
Lucerne, Amount of Water Used for ... 74
Mildura, Amount of Water Used ... 74
Need for Irrigation in South Victoria 73
Percentage of Run-off ... 73
Pipes, Capacity of ... 81
Rainfall at Doncaster ... 76
  Melbourne ... 76
Requirements, Water for Farm ... 75
Results at Doncaster ... 82
Silurian, Peculiarities of ... 76
Small Dams at Doncaster ... 78
Toolern, Irrigation at ... 82
Water Used by Cereal Crops ... 74
  Lucerne ... 74
Water Requirements of Farm ... 75

CHAPTER VI.

THE FARM HOMESTEAD.

C. BOGUE LUFFMANN.

Advantages of Well-thought-out Plans ... 89
  Orchards in Different Zones ... 105
Arrangement of Garden Lands ... 95
Books of Reference ... 106
Coast Region, Fruits for ... 106
Farmyards ... 92
  Arrangement of ... 92
Fruit Trees for the North ... 102
  For the Hill Region ... 108
  For the Coast Region ... 106
  Zones of Victoria ... 101
  List of Trees for ... 102 110
Garden, The Farmer's ... 95
  Types of ... 96
  Groups of Plants for ... 99
Hedges and Shelter Belts ... 94
High Land Orchard ... 108
Homestead, Site for ... 90
  Surroundings ... 91
Manure Pits ... 93
Method of Planting Trees ... 98
Mixed Farming ... 89
North Central Districts ... 109
Numbers of Trees for Orchard ... 107
Orchard, the Farmer's ... 100
  for the North ... 102
Paths About the Home ... 98
Planting, Method of ... 103
Pit for Manure ... 93
Points in Laying Out a Garden ... 98
Requirements for Different Fruits ... 111
Rules Governing the Orchard ... 101
Selecting and Forming Trees ... 107
Shelter for Garden ... 97
Six Groups of Plants ... 99
Soils for Different Elevations ... 111
Trees Round the Homestead ... 93
Trunk, Length of ... 112
Types of Trees for Zones ... 112
Vegetables to Grow ... 96
  Time of Sowing ... 97
  Uses on a Farm ... 96

CHAPTER VII.

ARTIFICIAL FERTILIZERS.

F. E. LEE.

Agricultural Value ... 133
Artificial Manures Acts ... 130
  Summary of ... 136
Bonedust, Phosphoric Acid in ... 119, 125
  Importance of "Fine" Material ... 123, 126
Calculation of Unit Values ... 131
  Commercial Values ... 134
Certificate to Accompany all Fertilizers 123
Cripples, due to lack of Phosphates ... 120
Digester Refuse ... 125
Factors which Determine Fertility ... 115
Farmers should Study the Certificate ... 129
Farmyard Manure and Fertilizers ... 128
  Deficient in Phosphoric Acid ... 129
Fertilizers, Definition of ... 117
  Distributed by Soil Moisture ... 120
Form of Plant Food to be Certified ... 123
Guano, Phosphoric Acid in ... 119, 125
Gypsum may be used with Super. ... 120
How to Calculate Commercial Values ... 135
Humus, Factors which Increase Amount 117
Kainit as Source of Potash ... 121
  for Insect Pests ... 122
Legislation, History of ... 130
Lime should not be used with Super. ... 120
Margin Allowed in Certificate ... 131
Manures, Definition of ... 117
  on Victorian Market, 1905 ... 124
Mechanical Conditions ... 122, 126
Mixing Manures ... 128
Moisture, Excessive, in Manures ... 128
Newspapers may Publish Results ... 137
Nitrates Absorbed by the Plant ... 118
  Readily Available ... 123
Nitrogen, Uses of by the Plant ... 117
  Fertilizers which Contain ... 117
  Does not Increase Yield of Wheat ... 117
  Its Value in Southern Victoria ... 117
  Cautions Respecting its Use ... 118
Nitro-Superphosphates ... 125
Phosphoric Acid, Forms in which it Occurs ... 118
  Best for Northern Wheat ... 119
  Improves the Grain ... 120
Plant Foods ... 116
Potash, Uses of ... 121
  Sources of ... 121
  Cautions Required in its Uses ... 121
  Nitrate of ... 127
  Not Required in the North ... 122
Potassic Fertilizers ... 126
Prices of Manures in 1905 ... 124
Publication of Results of Analyses ... 132
Real Value and Agricultural Value ... 133
Sulphate of Ammonia ... 124
Summary of Artificial Manures Acts ... 136
Superphosphates in 1905 ... 124
  Changes in the Soil ... 125
Thomas' Phosphate ... 119, 126
  Value in Clay Land ... 126
Unit Value, Meaning of ... 131
  Values, 1905 ... 132
Water, Soluble Phosphoric Acid ... 119
Wood Ashes ... 127

CHAPTER VIII.

WHEAT: INCREASING THE AVERAGE YIELD PER ACRE.

Hon. J. L. Dow.

Amount of Fertility Removed by Crop 142
Area *versus* Thorough Cultivation ... 158
Bare Fallow System 152
Capillary Condition of Soil Water ... 141
Causes of Good and Low Yields ... 152
Cultivation of Small Areas 158
Drilling the Manure, Advantage of ... 145
Dry Climate not Sole Cause of Failure 151
Evaporation, to Prevent 141
Fallowing, Method of 148
Food Requirements of the Crop 141
Grading Seed, Importance of 158
Gypsum Mixed with Super 145
Humus Kept up by Sheep 154
Irrigation for Wheat 160
Lambs, Value of 154
Lucky Seasons not the Rule 159
Methods Adopted by Representative Farmers 146
    For Irrigated Wheat 160
Nitrogen not Required in North 145
Pagan, G.. on Irrigation 160
Plant Food must be Dissolved in Water 140
Phosphoric Acid, Importance of 142
Prospects of the Wheat Market 138
Raising the Average Yield 150
Rape, Sown in the Fallow ... 148 154
    Rotation, Diagram of 156
Results of Experiments with Fertilizers 143 144
    Wheat Farming at Skipton 149
Rotation with Oats and Grazing ... 153
Run-off in Northern Victoria 141
Skipton, Lambs and Rape at 155
Sheep, Fallow System 152
Small Amount of Rainfall Required ... 138
Soils, Northern, Composition of 141
Sowing Wheat, Time of 148
Statistics, Australasian 138
    Victoria, by Counties 139
    World's Wheat Crop 139
Subsoiling, Effects of 147
Thomas' Phosphate, Action of 145
Three Years' Rotation 156 159
Varieties to Grow 146
Water, Amount Used per Acre 141
    Required by Crop 141
Yields, Variation in Adjoining Farms ... 151

CHAPTER IX.

THE POTATO.

Geo. Seymour.

Care of the Crop 171
Cultivation 164
Digging, Storing, Grading 171
Drainage for Crop 164
Evaporation, Effect of 163
Fertility of Soil, Maintaining 162
Food Value for Live Stock 250
Industry, Present Position 161
Manures, Artificial 165
    Farmyard 165
    Green 165
Moisture, Importance of 163
Planting, Time and Method 170
    Trench System 170
    Depth of 170
    Distance Apart 170
Roots, Length of 163
Rotation, System of 49
Seed, Care of 168
    Cut *versus* Whole 168
    Eyes, Value of 169
    Importance of Selection 165
    Method of Ditto 167
    Quantity per Acre 170
    Wild and True 166
    When to Use Large 167
Tilth, How to Make Deep 164
Timber, Influence of 162
Varieties, Adaptation 162
    Best to Grow 168
    Securing Pure 171

CHAPTER X.

MAIZE.

Jas. Cameron Esq., M.L.A.

Analysis of Green Crops 177 249
    Silage 251
    Corn 250
Amount of Soil Moisture Required ... 175
Caterpillar, Damage by 181
Check Row Planting 172 180
Coarse *versus* Fine Stalks 180
"Corn States," Statistics 174-6
Cribs, for Maize 183
Cultivation of Crop 181-2
Disposal of Crop 182
Early Experiences in Gippsland 172
Farmyard, Manure for 178
Food Value for Live Stock 177
Frosts, Injury by 181
Green Manuring for 178
Harrowing, Value of 181
Henry on Maize 174
Manures for 178
Molloy, A., Crops in South Gippsland 184
Need of Drainage 178
Need of Moisture 175
Planting, Methods of 178
Possibilities of the Crop ... 173 174 177
Preparation of the Land 178
Quantity of Seed for Acre 180
Rotation System 49
Seed, How to Secure First Class ... 184
Silo, Home-made 179
Silage, How to Make 183
Suitable Parts of Victoria 175
Value as a Farm Crop 177
Value to the Dairy Farmer 173
Varieties to Grow 173
When to Cut for the Silo 175
Yield in Australia 175
Yield in United States 174

CHAPTER XI.

TOBACCO.

TEMPLE A. J. SMITH.

Air Curing 198
Bulking Down 201
Chlorine Affects Quality 187
Cigar Leaf 189
Climate and Soils 187
Cultivation 194
Curing Methods 197
  Sheds 204
  Time Required 199
Cutworm, to Destroy 194
Diseases 206
Distance to Plant 189 194
Fermenting Cigar Leaf 202
Harvesting 196
Irrigation for the Crop 211
Need of Improved Varieties 187
Notes of Interest 208
Packing for Market 202
Preparation of Land 192
Production of Cigar Leaf 209
Prospects of Industry 207
Protection from Frost 192
Ragland's Method of Curing 198
Rainfall, Regular Required 187
Ridging Method of Planting 193
Seed, Amount per acre 190-1
  Beds, Management of 191
Shed, Cost of Building 206
Soils and Climate in Victoria 186-7
  America 210
  for Different Varieties 188 208
  Influence of 189
Sprouting Tobacco Seed 192
Stove for Heating Seed 204
Stripping and Classing 199
Sweating Process 202
Tent-grown Cigar Leaf 189
  Advantages of System 190
Topping 196
Transplanting 196
Varieties of 189
Wild Varieties in Victoria 212
Yield per Acre 189

CHAPTER XII.

VITICULTURE.—RECONSTITUTION OF VINEYARDS.

G. H. ADCOCK, F.L.S.

FINING OF AUSTRALIAN WINES.

M. d'A. BURNEY.

American Vines, Resistance of 214
Australian Ports, Characters of 232
Callusing 218
Choice of Finings 240
Clarification Assisted by Cold 231
Development of Resistant Vines 214
Differences in Fining Wines 231
Effects of Fining 246
Experience, Value of, in Fining 232
Explanation of Action in Fining 229
Fining, an Old Recipe 228
  Theory of 229
France, Reconstitution Experiments ... 215
Gelatine 236
  Amount to Add 237
  Preparation of 236
Grafting, Methods of 217
  Affinity 220
How to Fine 242
Hybrids, Development of 216
Isinglass 234
  Amount to Precipitate Tannin ... 236
  Preparation of 235
  Quantity per Hogshead 236
Implements for Fining 243
Lactocolle 237
  Preparation of 235
Lime, Influence of 220
  Estimation of 221
Method of Fining 244
Patent Finings, Observations of 233
Phylloxera, Natural Resistance to 213
Replanting Vineyards 218
Resistant Vines, American 219
Riparias, Characters of 216
  at Mooroopna 223
  Gloire 221
  Grand Glabri 221
Roughness due to Tannin 231
Rupestris, Characters of 216
  de Fortworth 227
  in Goulburn Valley 228
  duLot 224
  Ganzin 226
  Martin 225
  Metallica 226
  Mission 226
Salt, Injudicious Addition of 234
Sedimentation of Impurities 230
Spanish Clay 238
Sulphurous Acid, Action of 246
Tannin 238
  Amount Combining with Finings ... 239
Temperature, Low, Advantages of ... 230
Unsuccessful Fining 245
Victoria, Introduction of Resistant
  Stocks 215
Vitis Riparia 221
Vines, Varieties of 219
Weather, Influence of 242
When to Fine 241
White of Egg 233
  Amount of Tannin precipitated by ... 234

CHAPTER XIII.

FEEDING OF FARM ANIMALS AND MODERN SILAGE METHODS.

T. CHERRY, M.D., M.S.

Advantages of Silage ... 270
America, the Silo in ... 256
Animal Energy Compared with Steam Engine ... 247
Blower for Silage ... 268
Bulk Storage of Grain and Chaff ... 271
Carbo-hydrates, Functions of ... 247
Carbonic Acid Gas, Danger from ... 268
Composition of—
  Grain and Seeds ... 250
  Green Fodders ... 249
  Hay ... 250
  Mill Products ... 250
  Root Crops ... 250
  Silage ... 250
  Straw ... 250
Cost of Silos ... 264
Cows, Feeding Rations for ... 252
Crops for Silage ... 269
Digestibility of Food ... 248
Enlarging the Silo ... 267
Elevators for Silage ... 268
Failures in Making Silage ... 256
Feeding Silage to Live Stock ... 269
Filling the Silo, Details of ... 267
German Army Horse Rations ... 254
Green Fodder, Analysis of ... 249
Grain and Seeds, Analysis of ... 250
Hay, Analysis of ... 250
Heating of Silage, the Effects of ... 256
Horses, Feeding Rations for ... 253
  German Army ... 254
  Paris Omnibus Co. ... 254
Importance of Composition of Food-stuffs ... 247
Influence of the Brain upon Digestion ... 248
Materials for Silo, Tables of ... 259-264
Maturity of Crop for Silage ... 270
Mill Products, Analysis of ... 250
Modern Silage Methods ... 255
Notes on Building Silos ... 265
Nutritive Ratio, Explanation of ... 249
Overground Silo, How to Build ... 258
Paris Omnibus Co. Rations ... 254
Pigs, Feeding Rations for ... 254
Pressure Occurring in Silo ... 258
Protein, Composition and Functions of 248
  Value of ... 252
Root Crops, Analysis of ... 250
Sheep, Feeding Rations for ... 254
Silage, Amounts to Feed ... 269
  Analysis of ... 250
  Conditions to Insure Success ... 257
Specifications for Construction of Silos... 260
Stack Silage ... 271
Straw, Analysis of ... 250
Succulent Food, Importance of ... 255
Silo, Pressure Occurring in ... 258
  Stave ... 258
  Staying the Frame of ... 266
  Various Forms of ... 257
Value, Relative, of Food-stuffs ... 249
  Calculation of ... 251
Weighting Silage ... 268

CHAPTER XIV.

THE HORSE.—HEALTH FACTORS IN HORSE MANAGEMENT.

S. S. CAMERON, M.R.C.V.S.

THE AUSTRALIAN HORSE.

J. R. WEIR.

MULE BREEDING.

W. T. KENDALL, M.R.C.V.S.

American Trotter ... 288
Appetite ... 272
Arab, Types of ... 291
Attitude ... 272
Australian Draught Horse ... 279
  Light Breeds ... 284
Breathing ... 274
Breeding Draught Stock ... 283
Causation of Disease ... 274
Cleanliness, Importance of ... 279
Clydesdale, The ... 279
Coat ... 273
Commission, Indian, Report ... 285, 286
Deterioration, Cause of ... 285
Draught Horse, Australian ... 282
  Characters of ... 283
Ears ... 273
Eyes ... 273
Fæces ... 273
Feeding ... 277
Foal, Feeding the ... 283
Food and Water ... 275
General Management ... 278
Hackney, The ... 280
Heredity, Influence of ... 276
Hereditary Disease ... 276
Hoofs ... 273
Indian Remounts ... 288
Light Breeds, Australian ... 284
Lips ... 273
Mare, Kind to Breed Mules ... 297
Market for Mules ... 297
Mouth ... 273
Mucous Membranes ... 273
Mule Breeding ... 292
  Characters of ... 296
  Value of ... 294
  Why they are Profitable ... 294
Nostrils ... 273
Over-stocking, Effects of ... 274
Prevention of Disease ... 276
Pulse ... 274
Rearing Mules ... 297
Remounts, Indian ... 289
Shire Horse, The ... 280
Sire, Type of ... 289
  for Mules ... 296
Skin ... 273
Suffolk Punch, The ... 281
Temperature ... 274
Thoroughbreds, Some Notable ... 284
Unsoundness ... 277
Unwholesome Surroundings ... 275
Urine ... 274
Watering ... 277
Welsh Pony ... 287
What to Breed ... 288

CHAPTER XV.

DAIRY FARMING.

R. T. ARCHER; P. J. CARROLL.

Abortion in Cows, Treatment of 312
Advantages of Commodious Buildings ... 324
Aeration of Milk 334
Age at Which to Breed 301
Ayrshires 355
Babcock Tester, Use of 342
Bails, Method of Working 324
Barnyard Manure, Composition of ... 332
Blackleg in Calves 307
Breeds, Dairy, Choice of 301
Breed your own Heifers 301
Buildings on Dairy Farm 317, 324
    Construction of 321
Bull, Influence of on Value of Herd ... 301
    Importance of Selecting 300
    Management of 301
"Bullers," Treatment of 313
Burning off 299
Butter-fat, Computing the Contents ... 342
Buying Dairy Cows 300
Calves, Rearing 305
Calving, Management of 302
Camperdown Show, Records at 360
Clean Milking 304
Clearing Scrub 298
Cream Testing 350
Cold Weather, Effect of on Milk 331
Concrete, Directions for Making 326
Composite Samples for Butter-fat ... 341
Cow, General Appearance of 300
Dairy Farming Conserves Fertility ... 331
Dehorning Calves 307
Dirt to be Kept out of Milk 304
Dust, Bad Effects of 304, 319
Ear-marking Calves 306
Excitement, Injurious Effect on Milk ... 304
Feeding, Influence of on Milk Yield ... 301
    Calves, Method of 306
    Shed, Plan of 326
Floors, Construction of 323, 330
Fodder, Some Points in Growing 331
Foul, Treatment of 316
Garget, Treatment of 314
Gestation Calendar 310
Grass, Amount Required per Cow... 300, 303
Grass Seeds, Mixture to Sow 299
Growth of Fodder Crops 332
Heifers, First Year Milk Records ... 350
    Raise your own 301
    Age at Which to Breed 302
    to be Milked as Long as Possible ... 302
Herefords, Milking 352
Holsteins 352
Ill-health, Signs of 311
Increasing the Profits from a Herd ... 348
Irrigation to grow Fodder 333
Jerseys 357
    at Chicago World's Fair 358
Judging a Dairy Cow, Points for ... 308
Leading Breeds of Dairy Cattle 353
Ledger for Each Cow's Milk 345
Lice Affecting Calves 307
Lick for Cattle 311
Location of Buildings 319
Lung-worm in Calves 307
Milk, Care of 334
Milk Fever, Treatment of 314
Milking, Proper Methods 304
Milking Shed, Details of 325, 328
Monthly Record for each Cow 344
Overrun in Butter-making 342
Over-stocking, to be Avoided 300
Pig, as Adjunct to Dairy Farm 363
    Buttermilk as Food for 366
    Proportion of Meal to Milk 365
    Results Obtained from 364
    Separated Milk as Food for 364
    Whey as Food for 366
Persistent Milking, Value of 349
Profitable and Unprofitable Cows ... 347
Pregnancy, to Test for 302
Recipes, Useful 317
Record of a Herd for Twelve Months ... 346
Redwater, Treatment of 313
Refrigeration in Butter-making 334
Returns of a Good Dairy Herd 361
Ringworm in Calves 307
Rules for Producing Good Milk 337
Selecting a Dairy Farm 298
Shorthorns, Milking 353
    Records of 354
Separator, Use and Care of 339
    Loss Due to Faulty 340
Silage for Dairy Cows 333
St. Louis World's Fair, Milk Fever at ... 315
Stale Cream Makes Bad Butter 334
Sterility, Treatment of 301
Straining Milk 305, 338
Stumps, Stoving out 299
Subdivision into Paddocks 299
Testing for Butter-fat... 341
    Cows, Utility of 345
Too Many Cows are Unprofitable 304
Trees about Buildings 319
Udder, Inflammation of 314
Ventilation of Buildings 322
Water, Importance of Pure 303
    to Secure a Wholesome Supply ... 303
Yarram Show, Records at 360, 362
Yard, Construction of 330
Yearly Cost of Each Cow 347

CHEESE MAKING.

J. G. MACMILLAN, N.D.D.

Acidimeter 369
Aeration of Milk 370
Annatto, Mixing with Milk 371
Bandaging and Trimming 378
Bondon 394
Cambridge Cream Cheese 396
Camembert 397
Campbell, Prof., on Starters 384
Chart for Cheese-making 380
    Showing Relative Action of Starters 387
Cheddar Cheese, Making of 368
Chemical Composition of Cheese 368
Cooking the Curd 374
Coulommier 392
Curd, Testing for Acidity 375
Cutting the Curd 373
Double Cream Cheese 396
Dutch or Cottage Cheese 398
Fancy Cheese, Outfit for Making 389
Fast Milk, Treatment of 378

CHAPTER XV.—*continued.*

Faults in Cheese ... 379
Flavour Controlled by Micro-organisms 386
Food Value of Cheese ... 367
Gassy Milk, Treatment of ... 379
Gervais ... 393
Heating the Milk ... 371
Hooping ... 377
Hot-iron Test ... 375
Inferior Cheese, Causes of ... 367
Micro-organisms, Results of Experiments with ... 385
Milling ... 377
Outfit for Cheese-making ... 370
Philadelphia, or Square Cream Cheese ... 394
Piling the Curd ... 376
Pitching ... 375
Pont L'Eveque ... 390
Precautions in Use of Starter ... 388
Preparing Cheese for Market ... 381
Pressing ... 377
Pure Cultures for Starters ... 383
Renneting ... 371
    Variations in Action of ... 372
Rennet Test ... 388
Ripening of Milk ... 369
Salting the Curd ... 377
Starters for Ripening Milk ... 382
    Home-made ... 382
    Investigations with ... 383
    Management of ... 389
St. Ibel ... 395
Stirring the Curd ... 374, 376
Straw Mats for Fancy Cheese ... 390
Swiss Cream Cheese ... 396
Treatment of Fast Milk ... 378
Value of Cheese as Food ... 367
Varieties of Cheese, Composition of 368
Whey, Acidity of ... 378
    Separation of ... 374

CHAPTER XVI.

POULTRY.

H. V. HAWKINS.

POULTRY FOR EXPORT.

A. HART.

All-round Fowl, The ... 409
Australasian Statistics ... 400
Breeding and Management ... 401
    Pen ... 402
Breeds to be Avoided ... 411
Brooder Houses ... 419
Broody Hens ... 414
Chickens, Hints on Feeding ... 416
    Housing ... 417
    Pox, or Fowl Warts ... 421
Consumption of Poultry in Great Britain ... 400
Celling Out Unprofitable Birds ... 409
Diseases of Poultry ... 420
Drinking Vessel ... 406
Ducklings, Management of ... 437
Ducks for Export ... 434
    Management of ... 428
    Points on Management of ... 438
    Varieties to Breed ... 434
Dust Bath ... 406
Early Chicks, Importance of ... 410
Early Eggs, Breeding Ducks from ... 432
Egg Eating ... 425
Egg laying Competition, Results of ... 401
Export, Best Breeds for ... 410, 439
    of Poultry ... 438
Fattening for Export ... 440
Feather Eating ... 425
Feeding the Poultry ... 411
    Ducks ... 435
Field System ... 427
Floors ... 406
Foster-mother ... 419
Gapes ... 425
Grit Box ... 406
Heat Apoplexy ... 424
Houses, Construction of ... 403
Housing Ducks ... 429
Incubating Duck Eggs ... 436
Incubation ... 414
Incubators ... 417
    Electric Regulator ... 418
Locality, Importance of ... 402
    for Duck Farm ... 429
Management of Ducks ... 432
Manure, Value of Poultry ... 427
    Composition of Poultry ... 428
Mixed Diet, Necessity of ... 412
Nineteenth Day, Importance of ... 415
Oats as Poultry Feed ... 413
Parasites ... 424
Pen for Ducks ... 430
Perches, Vermin-proof ... 405
Points on Management of Ducks ... 438
Portable Pens ... 425
Poultry for Export ... 438
Prices Obtained on London Market ... 439
Rations for Fowls ... 412
Remedies, Standard ... 421
Roup ... 422
    Diphtheric ... 422
Scaly Leg ... 423
Season for Export Trade ... 440
Shelter and Shade ... 403
Sick Fowls, Care of ... 420
Stud Birds, Selection of ... 407
Temperature of Young and Old Poultry 415
Tick, Prevention of ... 441
Tick-proof Fowl-house ... 442
Trap Nests ... 406
Why Chicks Die in the Shell ... 413

CALENDAR FOR FARM, ORCHARD, FLOWER, AND VEGETABLE GARDEN ... 443

CHAPTER I.

INTRODUCTION.

In estimating the present position of agriculture in Victoria, the subjoined table, which has just been issued by the Government Statist, is of interest. It will be seen that out of a total of 52,598 holdings, there are 25,943 (or very nearly one-half) that are less than 200 acres in extent. Of these, 1 acre out of every 4½ is kept under cultivation, as compared with 1 acre out of every 8 for the whole of the occupied portions of the State :—

Classification of Agricultural Holdings, 1905.

Size of Holdings.	Number of Holdings.	Extent of Land Occupied.	Extent of Land under Cultivation.	Percentage of Land Cultivated.
		Acres.	Acres.	
1 acre to 5 acres	2,374	7,252	3,131	43·1
6 acres to 15 acres	3,379	34,171	14,743	43·1
16 acres to 30 acres ...	3,740	80,124	27,150	33·8
31 acres to 50 acres	3,284	134,226	36,206	27
51 acres to 100 acres ...	5,565	419,849	96,469	23
101 acres to 200 acres ...	7,601	1,142,431	225,522	19
201 acres to 320 acres ...	7,813	2,138,081	499,130	22·8
321 acres to 500 acres ...	5,349	2,166,474	531,303	24·5
501 acres to 640 acres ...	3,860	2,262,269	663,260	29·2
641 acres to 1,000 acres ...	4,111	3,333,832	735,636	22
1,001 acres to 2,500 acres .	4,055	5,975,438	1,035,226	17·3
2,501 acres to 5,000 acres ...	834	2,779,409	216,034	7·7
5,001 acres to 10,000 acres ...	309	2,162,458	42,808	2
10,001 acres to 20,000 acres ...	180	2,563,302	20,905	·8
20,001 acres to 50,000 acres ...	121	3,549,351	13,957	·4
50,001 acres to 100,000 acres ...	15	983,948	5,835	·6
100,001 acres and upwards ...	8	2,448,433	8,299	·3
Total	52,598	32,181,048	4,175,614	13

The total area under wheat is returned at 2,308,000 acres, comparatively little of which will be cut for hay. The estimated average yield is over 10 bushels. It is satisfactory to note a steady improvement in farm methods—more than 1,500,000 acres having been manured this season, while it is estimated that there are at present 900,000 acres under fallow. The results of 23 wheat fields in which experiments have been conducted by the Department show that 56 lbs. of ordinary superphosphate (averaging about 20 per cent. phosphoric acid) have yielded 18 bushels to the acre, as against 15.6 bushels with 40 lbs. of super., and 12.6 in the unmanured plots. This indicates not only the value of phosphatic manures, but also the fact that it is not wise to reduce the application much below 56 lbs. to the acre. The experience of the present harvest confirms the generally accepted opinion that early fallowing goes far to insure the crop against the effects of a deficient rainfall. Wheat is now grown on considerable areas of the central and southern districts where the rainfall is much higher than that of the north. For instance, in the county of Ripon nearly 50,000 acres are harvested with a probable average of 20 bushels, under an average rainfall of 24 inches. Considerable areas are also under wheat between Melbourne and Geelong with equally good returns. Experiments on land at Stawell and elsewhere, which has hitherto been thought too poor for cultivation, have shown the wonderful response such soils make to phosphatic manures.

A large number of varieties of wheat and oats have been tested this season in 23 localities, manured with 56 lbs. super., and grown under precisely the same conditions as an ordinary crop. The three best were—Jade, 19.1 (maximum, 33); Federation, 18.9 (maximum, 34); and Dart's Imperial, 18.2. As these averages include the Mallee fields (5 out of 23 localities), which only averaged 10.5 bushels, it will be seen that selection of varieties opens up the possibilities of nearly doubling our present yield of wheat. The drought-resisting varieties obtained from Africa, America, and Russia have not given results comparable with the above. The oats, which also include the Mallee fields, have resulted in the Algerian variety being first with 28.3 bushels to the acre. Tasmanian Giant White, 26.7, and Stout White, 23, were next best.

OTHER CROPS.

As contrasted with the steady advance in wheat farming, I regret to report that there is a very marked diminution in the other crops, including oats, barley, potatoes, and onions, where one acre out of every four has gone out of cultivation since 1903. In the case of the root crops the yields in recent years have not been very satisfactory; and the Department of Agriculture is attempting to place the potato industry in particular on a new footing. In this connexion it is anticipated that the experimental fields which have been planted this season will prove as valuable to the grower in the southern districts as the experimental wheat fields have done to the northern farmer.

The dairying industry continues to show steady and satisfactory expansion—the number of milking cows being now returned as 620,000, an increase of 20 per cent. since the census of 1901. Producers generally are waking up to the importance of supplementing the natural grasses by suitable fodder crops, and the use of ensilage for both summer and winter feeding is making steady progress. On the other hand, with the exception of a slight increase in the number of sheep, we find that the number of horses, cattle, pigs, and sheep has remained almost stationary, or has actually diminished, during the last five years.

The chief reason for this unsatisfactory state of affairs is simply the fact that most farmers in Victoria have more land than they utilize, and they are able to obtain a good living from it without working the greater part of it to anything like its full stock-carrying capacity. The more general adoption of the cultivation of such plants as lucerne in the northern areas, and maize in the southern districts, would at once enormously increase the stock-carrying capacity of every farm.

EXPORT TRADE.

The export trade shows a steady expansion in almost all lines, as will be seen from the accompanying figures. The grading of butter, poultry, and rabbits by the officers of the Department is now well established in public confidence, and it is satisfactory to note that the voluntary grading of wheat, oats, potatoes and other produce is making steady progress. The reduction in the freights by the contract entered into by the Government in June, 1905, has already produced notable results, for, in addition to the immediate saving in freight (some £70,000 for Victoria alone), a slight, but appreciable, increase in the prices of the produce in the Melbourne market is already apparent.

The export trade in fat lambs shows indications of a very marked expansion; and the facilities which now exist for the shipment of this class of produce from Melbourne and other Victorian seaports have greatly enhanced the price which the farmer is receiving for his stock. Last year some 15,000,000 lbs., worth over £200,000, were shipped for export. The extent to which rape and other crops are being worked in with a system of rotation, including wheat and grazing, augurs well for the permanency of this industry.

Victorian Oversea Exports.

Leading Agricultural Products.—Year ended 30th June, 1905.

Wool	£5,512,384
Mutton	232,317
Rabbits and hares	192,515
Wheat	2,677,437
Flour	524,356
Oats	137,735
Butter	1,191,554
Sheepskins	485,153
Leather	173,853
Tallow	111,063
Wine	61,405
Eucalyptus	16,000

Victorian Trade, Oversea and Inter-State.

	1901.	1902.	1903.	1904.	1905
Imports ...	£18,927,340	£18,270,245	£17,859,171	£20,091,951	£22,317,195
Exports ...	18,646,097	18,210,523	19,767,068	24,404,917	22,706,694
	£37,573,437	£36,480,768	£37,566,239	£44,496,868	£45,023,889

ADVANCE WORK BY THE DEPARTMENT OF AGRICULTURE.

The experimental fields worked and cultivated by the Department number 90, and comprise an area of nearly 700 acres. Twenty-eight 10-acre wheat experimental fields are scattered through the whole of the Northern areas. They are devoted chiefly to manuring, cultivation, and variety tests in connexion with wheat, oats, and fodder crops. Twenty forage fields, chiefly in the Southern districts, are devoted to experiments with cereals, roots, potatoes, and summer fodders. Forty pasture fields, usually 10 acres in extent, are being worked to ascertain what can be done to improve poor grazing land at a moderate cost, namely, 2s. 6d. per acre for manures, and 2s. 6d. per acre for seeds.

In addition to these, investigations are being carried on to test the capabilities of land which up to the present time has been looked upon as too poor for satisfactory agricultural settlement. There are 200,000 acres of Crown lands of this character in the Cape Otway district, and a much larger area in South and Eastern Gippsland. It is found on analysis that the land is of moderate fertility, and, as the result of the drainage effected during the last few months, notable improvements in the appearance of the soil can already be seen. With the application of moderate dressings of superphosphates, there is little doubt that nearly the whole of the light sandy soils in Southern Victoria can be turned to good account. The rainfall is ample, and there is no reason why the same transformation should not be worked in districts remote from Melbourne, as has already been accomplished in the neighbourhood of Caulfield and Brighton, on soils of exactly the same character. These soils seem to be particularly adapted for the growth of potatoes and other root crops, and, in many cases, for fruit culture. Experiments carried out by the Department in previous years have already proved that they grow sugar beet to perfection; and in connexion with the efforts which the Government are making to permanently establish the beet sugar industry in Victoria, the possibilities of settling and cultivating these lands have not been overlooked.

It is gratifying to be able to report that a small crop of tobacco grown on the Government farm at Edi has realized the very satisfactory price of 1s. per lb. for the unfermented leaf. Great possibilities with regard to the cultivation of tobacco undoubtedly exist in the alluvial soil in the valleys of the Eastern portion of Victoria, and, with the extensive markets which have been opened up throughout the Commonwealth, we anticipate the steady extension of tobacco-growing.

EDUCATIONAL WORK.

The response to the offer of the Department to establish Agricultural Classes, the interest which is everywhere being taken in the results of experimental work, and the advance which has taken place in educational methods generally, make it desirable to review the position with regard to the education of the farmer. The introduction of nature study and experimental science into the State schools has laid the foundation, while the establishing of a degree in Agriculture at the University has completed the superstructure. The present seems a fitting opportunity for considering what can be done to bring the advantages of a more thorough training within the reach of every one who obtains his living from the land.

What other Countries are doing.

While the final grades of agricultural education have been long provided for in Europe and America by colleges and chairs at the Universities, it is only of recent years that interest has really been awakened to the requirements of boys and girls after they leave the primary schools. It has been recognised that science lends a helping hand to agriculture through the medium of improved methods, and of recent discoveries, but educationalists have just awakened to the possibility of the great advantage to the majority of the children of farmers if their education can be carried on for one or two years after leaving the primary school. Everywhere there are complaints that population flocks into the city. The question is: Can anything be done to prevent this by moulding the character of the boys and girls so that they become enthusiasts for country life and for country pursuits? Among the earliest attempts to solve this problem are the "Farmers' Schools" of France, established in 1824. Under this system the boys were practically apprenticed to some of the leading farmers in an agricultural district, and learned the practical work of the farm in the same way as they would have done at any other trade. Little attempt was made to further their general education. On the other hand, reading lessons in agriculture were early introduced into the National schools of Ireland. In the case of France we have an example of practice without theory, and in the case of Ireland of theory without practice, and both have failed. Briefly, we may say that in recent years, it is everywhere recognised that theory and practice must go hand in hand—"that in each of the sciences bearing upon agriculture there are a few great principles which may without difficulty be mastered by a boy, and their application to agriculture may at the same time be fairly shown and verified by practical demonstration and by actual experiment. It is absurd to try to make the farmer a chemist, or botanist, or physiologist; but the laws of nature in soil, and plant, and animal are to be his friends or enemies throughout life, and it is essential, if he wishes them to be friends and servants, that he should understand their ways." In Denmark, we find that the practice most generally adopted is for the youths of both sexes, who have completed the primary course, to attend secondary schools for about six months every year. In these, science is taught to all pupils, but it is distinctly subordinate to the literary side of their education. Practice is obtained by working on their fathers' farms or on those of some of the neighbours for the other six months of the year. Indeed, the sons of well-to-do farmers, who wish to become expert agriculturalists, hire themselves out to the best farmer in the neighbourhood, and do all the work in the same way as an ordinary labourer. Some such combination of practice and theory is thus obtained in most Scandinavian countries. Reliance is placed upon furthering the general education of the farmer by developing what is called a "cultivated common sense." The progress of the northern races depends upon the combination of this side of their character with sound agricultural practice.

With the development of manual training and other practical work in the primary schools of both England and America, the opinion is steadily gaining ground that the true solution of the problem of education for the farmers' sons is to be found in a combination of literary work, scientific study, and practical farming. Under the title of "A Plea for a Great Agricultural School," the following seem to be the conclusions of Mr. James Mortimer, head master of the Grammar School and County School of Agriculture, Ashburton, Devon. (1902):—

> "I should not, however, advocate the above course of study unless it could be combined with actual manual labour. No study of an operation can be of much use, unless one takes part in it oneself. The farmer, whose training we are describing, must be more or less a worker, and his school life ought to afford him opportunities for the training of those muscles and the acquiring of that manual skill which he will have to use afterwards. This manual work should be of a very varied kind. In the carpenter's shop and smith's shop, under careful teachers, he might learn the use of the various tools

in wood and iron work, and some knowledge of welding and soldering, which would undoubtedly be of service in his after life. Each boy, according to his age and strength, could have suitable work opportioned him in the byre or the dairy, and in fine weather in the garden or the field. Strong lads of fifteen or sixteen can be taught ploughing and harrowing, hedging and ditching, the management of machinery under supervision, some of the operations of the harvest-field, and many little tasks necessitated by the keeping of stock could be done by boys. In a school with a high tone, the most menial work could be made honorable; and that end could be attained which of all others is at the present time most to be desired for our English youth, the raising of manual labour to its true position as one of the essentially noble forms of human activity." (Page 643.)

. . . . .

"The main branches of the farmer's education then should be—

1. Natural science as bearing upon agriculture.
2. Mathematics and relations of measurements, and valuations of business methods.
3. Manual work such as will enable him to acquire strength and skill in all the operations required on the farm; and
4. Elevation of his higher nature, to cultivate in him a taste for what is great and good and beautiful in art, history, and in literature."

Take another example from America. L. D. Harvey, State Superintendent, Wisconsin, writes with regard to agriculture and domestic economy in rural industries, as follows (1900):—

"A new class of schools needed in rural communities, to be known as county schools for instruction in agriculture and domestic economy. . . . .

"Extend the idea upon which the county training schools for teachers were organized so as to provide for the establishment of county schools for instruction in agriculture and domestic science. Give to any county establishing such a school State-aid to the amount of at least one-half the sum actually expended for purposes of instruction in such school. Admit to these schools boys and girls who have at least completed the course of instruction in the elementary schools, and who have reached the age of sixteen. Provide for courses such as I have already considered in discussing the body of knowledge which should be taught, including manual training, and make the course two years in length. Add to the courses already indicated such instruction in language, literature, history, and mathematics as may be carried on in connexion with the other work. Such a school should have in connexion with it a small tract of land to be used for illustrative and experimental purposes; not the line of experiments which the agricultural experiment station undertakes, but a more simple line which could be carried on under the direction of the teachers, and which would be of value for observation and training purposes. Such a school could give, in addition to the other work, a great body of the work now given in the short courses in agriculture offered in our agricultural colleges, and it could carry on work in some lines considerably in advance of what is now undertaken in those short courses."

Can any Knowledge of Agriculture and Kindred Subjects be properly taught to Children of from fourteen to seventeen years of age?

As has already been indicated, this question is almost universally answered, in other countries, in the affirmative, but two methods, sharply distinguished from each other, are used to attain the object in view. We have the first method recently adopted in Canada and long in vogue in the National schools of Ireland, in which a text-book on agriculture is placed in the hands of school children, and the lessons committed to memory, with illustrations drawn in some cases from the school garden, to lend a practical interest to these studies. At the other extreme, we have the farm schools of France run upon purely "practical" lines. Here the children were placed in charge of some of the largest and best farmers in the district, the chief attention being devoted to the pupils becoming acquainted with all the practical details of the different operations of agriculture, while the corresponding book work was comparatively neglected. The fact that these schools have, within the last ten years, been completely abandoned in France indicates that, at all events, they do not fulfil the objects for which they were established. Between these two extremes, we find every variety of expedient. In all cases it must be admitted that there is a great deal which children should be taught after they have left the primary schools which ought to fit them for more completely fulfilling the duties of their future sphere of life. The most reasonable position to take, in our opinion, is the stand-point adopted in Denmark, Belgium, Hungary, and some of the leading agricultural States in America adapting their system to the special circumstances of rural life in Victoria. It must be remembered that Victoria differs from almost all other countries in the fact that there are no class distinctions, the vast majority of the farmers are fairly prosperous and hold large areas of land, nearly all avail themselves of our far-reaching system of State education, and the conditions of labour are such that each farmer has, to a very large extent, to trust to his own exertions. The system, therefore, which answers admirably among the peasant proprietors of Denmark or France cannot be transplanted without alteration to our State. If Denmark and France depend upon their educational systems to keep them in the van of agricultural progress, it needs scarcely to be argued that our farmer requires to be more highly educated still. To compete with foreign countries we require to be able to make full use of all the powers of nature, to utilize our live stock to the best advantage, and make machinery do as much as possible. In other words, we require to be prepared and equipped to take full advantage of every advance which has been made in the theory and practice of agriculture and to adapt our methods promptly to the ever-varying circumstances which competition is bringing about. As an example may be noted the changed outlook with regard to the cultivation of wheat in all parts of Victoria—the old single-furrow plough has been replaced by implements requiring six or eight horses to draw them; 3s. worth of manure to the acre has restored the fertility of the worn-out lands; the well-worked fallow has rendered available much of the locked up fertility of the soil; and all the operations of cultivation and harvesting are carried on by expensive and complicated machines. Scientific methods of storing the grain during last harvest would, in many cases, have been equivalent to an additional 3d. per bushel for the crop. Knowledge, resourcefulness, and business capacity are manifestly of value in every stage of the wheat industry. Precisely similar facts might be quoted to illustrate the importance of knowledge in connexion with all our staple products. Where the activity of the farmer is centred round the animal rather than round the plant, knowledge and resourcefulness become more important still. We take it as beyond question that a farmer's mind requires to be educated in the widest sense of the word, as well as stored with the bare facts of agricultural practice gained from experience alone. To apply his knowledge and experience he requires not only to know what to do, but also to know why he does it. Circumstances and conditions vary so much from year to year that rule-of-thumb methods very soon become obsolete. Therefore, in order to make a success of farming at the present day, it is advisable that the laws of nature as they are found in connexion with the soil, the plant, and the animal, should form subjects of study. A farmer should grow up familiar with the great practical principles which result from an understanding of these laws. Minute details may be left to the higher colleges and university education, but the chief facts should form part of the stock in trade of every one engaged in agriculture. In such subjects as the soil, rainfall and water supply, cultivated plants, animal life, the economics of agriculture, manual training, domestic economy and hygiene, there is a wide range of study bearing directly upon the success of the student in after-life; each and all of them come up before the farmer in his every-day duties; they are the things which he reads about in the newspapers and journals, which take him to the markets and shows, which bring him to town on business, and which, unconsciously perhaps, absorb practically the whole of his mental energy. There is no question at all of their scope and importance. In comparison with them, the amount of knowledge required by the artisan, the manufacturer, or the man of business seems comparatively insignificant. Each of these subjects comprises a wide range of details; and to attain a high standard of excellence in any of them requires specialization. We seldom find a first-class dairyman who professes to know much about sheep, and *vice versâ.* If a man is to acquire a sound knowledge of the rudiments of them all, it is certain that his education must be carried on systematically and practically. To leave him at the stage where he is left by the present State school syllabus is emphatically not sufficient. His needs should be provided for by a system of continuation schools, in which his studies are kept to those subjects bearing directly upon his life work. The attempt to secure the young farmer after he has left the State school for a number of years, and bring him back to educational work, either at the short courses of study on agricultural subjects or at an agricultural college, does not give satisfactory results. In the meantime, other claims and duties have occupied his time. From the age of fifteen to twenty he has practically fallen out of the habit of serious study. As a general rule, he is not so well up in the ordinary State school curriculum as he was at the time of leaving; and the attempt to resume the habits of study is difficult enough, even were the subjects the same as those he had been formerly accustomed to; and when entirely new subjects are attempted, when, so to speak, he has to learn the language of science from the beginning, failure is almost certain to result. It is attempting to climb up an educational precipice instead of ascending by an inclined plane.

A striking instance of the benefit of using the discipline of education to improve the industrial conditions of society in the country is seen in the case of Denmark. The Danes rely almost entirely on what they call the highly-developed common sense of the farmers. They claim that this is chiefly due to their system of rural high schools; and it is noteworthy that in these high schools there is less attempted on purely practical lines than in any other system of agricultural education of the same grade. It is this system of education which has raised the Danish peasant from being amongst the poorest in Europe to his present position at the top of the tree. It is noteworthy to observe what crises in the history of Danish agriculture have been successfully overcome simply by the intelligence of the farmers. Twenty-five years ago it was found that raising grain for export ceased to be profitable. They immediately changed their system of farming, established their present system of dairying, and bought cheap grain from foreign countries to supply food both for themselves and for their live stock. Hardly had the dairying become fully established when swine fever broke out in a most virulent form. The export of live swine fell from 300,000 in 1886 to 16,000 in 1888, yet they successfully controlled the disease and built up their present ham and bacon industry, which now ranks second in importance to the export of butter. Again, in 1897, it was discovered that nearly half of the dairy cattle in many districts in Denmark were affected with tuberculosis. The farmers set to work at once intelligently to apply the regulations of the Danish Minister of Agriculture, with the result that at the present time the disease has been almost completely eradicated. There is probably no State in the world where the successful carrying out of all details connected with farming interests is left so much to the educated "common sense" of the farmer.

That a judicious combination of science teaching and literary work forms the ideal system for educating the future farmer, in the wider sense of the word, is a proposition that is not likely to be disputed. We have indicated already some of the ways in which this education may be made to equip him specially for the work of the farm. Assuming that the foundation has been laid in nature-study and in elementary science at the State school, the science of the first year at an agricultural high school might comprise physics, chemistry, mathematics, English, the outlines of physiology and geology, drawing, and bookkeeping (domestic economy and domestic hygiene, if girls are included in the scheme).

The second-year work, while continuing the English studies, might comprise botany, zoology, meteorology, and agriculture. Under the latter would be included the soil, farm operations, fertilizers, plant production, and the live stock of the farm.

Starting in this way from the great principles which underlie all natural science, and working up gradually to their special application to agriculture, verifying and illustrating each step by the work which the pupil himself does in the practical courses (which would form at least one-third of the total work of the course), we think that agricultural knowledge treated in this way may be made the basis for a fuller and more thorough equipment for the future work of the farmer.

ORGANIZATION OF AN AGRICULTURAL HIGH SCHOOL.

In a country centre where an attendance of 50 to 100 pupils could be guaranteed, the Agricultural High School should be worked in connexion with the local State school, controlled by the Education Department, but managed with the advice and co-operation of the Department of Agriculture and a local committee. The staff would consist of teachers specially selected by the Education Department on account of their fitness for work of this kind. The ordinary hours of attendance would be enforced, and the school, generally, conducted on the same lines as the Continuation School in Melbourne, but with all the subjects tending in the direction of agriculture. As already indicated, these subjects would be almost exclusively scientific; and the education would be largely a training of the hand and eye and powers of observation through the medium of practical work. Laboratories, workshops, and an area of land for experimental work would, therefore, be necessary. Its aim would be to impart a sound knowledge of the fundamental principles of the sciences which underly agriculture, together with a knowledge of the methods by means of which these principles are carried into practical effect.

In a school of this type the aim should be to continue the education of the boys and girls in subjects of direct advantage to them in future life. A small farm should be attached to each of the schools, and in this farm all the ordinary and special operations should be carried out by the students themselves. A sound training in farm methods may be given on a small area of land without difficulty. About two-thirds of the time should be devoted to school and laboratory work, and one-third of the time to practical work on the farm. The heaviest part of the cultivation could be carried out each year with a horse and plough, but after the rough work was thus done, the experimental and demonstration work in connexion with cultivation, drainage, manuring, conservation of moisture, &c., could be carried out on a series of small plots by a few of the students working together. Ample material for the practical work for the advanced classes could be found in special problems, such as selection of seeds, introduction of new varieties, the improving of existing varieties and many other points which involve close observation, extended over a large number of individual specimens of plants.

Such work would develop the faculties, quicken the power of observation, and engage the interests of all the students; while in a few years' time 10 acres of land worked on this principle would constitute a most valuable experimental plot for the purposes of the Agricultural Department. At the present time, upwards of £3,000 a year is spent in experimental work on about 70 plots scattered throughout the whole of Victoria. The weak point of the present system is due to the fact that it is impossible to supervise each plot so as to keep continuous accurate observations going on, and so as to carry out each operation precisely at the right moment. A dozen school farms would, we think, be much more satisfactory from both of these points of view, and furnish results of much greater value than our present experimental plots. Arrangements might be made with the local Agricultural Societies, through representatives on the local committee, to do the ploughing and harrowing when required, and to advise the Director of Agriculture generally with regard to the special management of these plots. The interest of the whole of the surrounding agricultural community would thus be centred in the school. The interest which the children would have in the plots would keep the work under the notice of their parents, and we have no doubt that the influence of the experimental work of the Department of Agriculture would become more far-reaching by this means than by any other method.

The equipment, therefore, for an Agricultural High School would consist of two class-rooms, two or three work-rooms and a school farm of at least 20 acres. The buildings should, if possible, be erected in the same enclosure as the State school, or at all events close at hand; so that the two schools may be under the one head-master, and the staff of the one school be available for special work at the other. The farm should be within reasonable distance—say, not more than 2 miles away—while it would be an advantage to have the farm immediately adjoining the school buildings. We estimate the average cost of the buildings and equipment at £1,500. The land for the farm, for the most part, could be secured from neighbouring public reserves, but an additional £500 would be required for getting the farm in order and equipping it with the necessary tools and appliances for the students. The fees collected from pupils will pay about two-thirds of the cost of tuition in the case of 50 students. In the case of 100 students, the fees will pay nearly the whole cost of tuition.

In districts where Schools of Mines or Technical Colleges are already in existence, it is possible that some arrangement could be made whereby the work of such a college could be amalgamated with the work of the High School. This would necessitate the Department of Education practically taking over the whole control of the collége; but as the special circumstances of the School of Mines, &c., vary in each centre, we would suggest that no general scheme be formulated for dealing with them, but that each be treated separately when occasion arises. In any case, only the small Technical Schools would be considered in this connexion.

In order to secure the interest of the farmers in the neighbourhood, a local committee should be formed to assist with its advice in the general curriculum of the school, and to take a specially active part in the work of the school farm and the experimental plots connected therewith. In many cases such a committee could be elected by municipal councils, agricultural societies, and private subscribers to the funds of the High School. They would not have power to appoint or dismiss teachers directly; but by giving them an active part in selecting the teachers from a list supplied by the Department, and in co-operating with the Department of Agriculture in the cultivation and general management of the plots, there is little doubt that sufficient local interest would be maintained to secure the co-operation of an active committee.

Since the above was in type the proposals to establish Agricultural High Schools have been advanced another stage by the decision of the Government to devote the sum of £3,000 for this purpose during the current year. This sum is made available under the following conditions:—

(*a*) At least one-half of the cost of the necessary buildings and equipment shall be contributed by local subscriptions.

(*b*) An area of land of not less than 20 acres situated in a convenient position to the High School shall be provided and vested in the Minister of Public Instruction.

(*c*) At least 50 students paying prescribed fees shall be guaranteed before the proposal to establish an Agricultural High School is entertained.

It is proposed that pupils for admission to the High School must be at least fourteen years of age, and have obtained the Certificate of Merit at the local school, or have passed the primary or some higher examination at the Melbourne University, or must have satisfied an Inspector of Schools they are qualified to profit by the course of study.

A local Council will be appointed for each district High School, and will exercise a general oversight over the work of the school, particularly with regard to the farm operations, and expend the maintenance allowance allotted to the school. In addition they will nominate for free instruction students who possess the above qualifications, provided the number of students so nominated shall not in any year exceed 10 per cent. of the total number paying full fees enrolled at the school.

The proposed courses of study are practically on the lines indicated on page 25, and it is proposed that the schools shall be attended by both girls and boys.

CHAPTER II.

THE SOILS OF VICTORIA.

While our present knowledge is not sufficient to enable us to give a detailed account of all the soils of Victoria, we know enough to indicate a few general principles which govern the possibilities of development, as well as the method of treatment that promises best results in the way of improving these soils.

The *character* of the soil is dependent on that of the rocks from which it was derived, and although these rocks are usually within a reasonable distance, this is not always the case. In the course of ages the whole of the soil may have been transported vast distances by water and the wind. Every shower of rain washes down something from the high lands on to lower levels. Streams are continually wearing away rocks, and carrying grains of sand and silt towards the sea. In many parts of the Mallee the bare edge of the sand may be seen drifting eastward before the prevailing winds. The *fertility* of the soil is dependent partly on the nature of the parent rocks, partly on the size of the grains of which it is composed, and partly on the character and amount of the vegetable and animal life which it has supported during the last few thousand years. But above all these, the amount of the rainfall, and the consequent leaching of the soluble chemical constituents is perhaps the most important of all. It has been known for ages that where arid regions are brought under irrigation, they prove to be most remarkably fertile. Hilgard, of California, has shown, from a systematic examination of the soils of the United States, that there is not only an unusually large amount of plant food available in them, but the influence of the high summer temperatures which prevail in most irrigated districts stimulates all plant life when once the water is supplied. These peculiarities will be mentioned more in detail later on, when treating of the Northern and Southern plains respectively. Twenty years ago it was supposed that a chemical analysis of the soil would enable the farmer to know what his soil would grow, and what manures it required, but further experience has shown that the chemical composition is only one of a number of factors, all of which have to be known before a reliable opinion can be formed. Some of these factors are not ascertainable without calling in the help of the growing plant, and therefore the method now adopted is that of the experimental plot. Here the questions are put to the plant, and the resulting growth of the plant under varying conditions gives us the answers we are seeking.

PHYSICAL FEATURES OF VICTORIA.

There are five distinct types of country in Victoria. First, the mountain ranges and elevated plains, extending from the eastern boundary as far as the Grampians and other ranges north of Hamilton. In area it occupies about one-third of the whole of Victoria. The highest ridges form the so-called Dividing Range, while massive spurs extend northwards towards the Murray and south into Gippsland. The greater part of this country lies to the east and north-east of Melbourne, forming a block more than 200 miles from west to east by 130 from north to south. The hills of South Gippsland may be looked upon as a detached portion of the same area. West of the line joining Melbourne and Rushworth the older rocks, which form the hills, have been covered to a considerable extent by volcanic action in comparatively recent times. The granites and slates, however, are found in more or less detached areas, and form the principal gold-fields of Victoria, extending from Heathcote to Ararat. The western buttress of the hill country consists of the sandstones of the Grampians, Sierra, and Victoria Ranges. Another detached portion of this area is found in the Cape Otway Ranges, corresponding in geological characters and geographical position with those of South Gippsland.

Second, the Northern Plain extends from the foot of the mountains to the Murray as far as Swan Hill, and thence from the foot hills to the southern edge of the Mallee, this line passing in the neighbourhood of Boort, Charlton, Donald, Warracknabeal, and Dimboola. Its average elevation is from 600 to 250 feet above sea-level.

Third, the Coast Plain, extending along the coast and varying in width from 50 miles to nothing. West of Portland it sweeps round the edge of the volcanic region and the hills to join the Northern Plain along the South Australian border.

Fourth, the volcanic region, the main part of which forms the "Western District." Most of this consists of the "newer volcanic," extending from Seymour and the foot of the Plenty Ranges to the Hamilton and Portland Railway. Its northern boundary overlies the older hills from Hamilton to Kilmore, with northerly extensions through Carisbrook to Bridgewater, and through Kyneton to Axedale. Its southern boundary runs from Geelong to Cobden, and thence along the sea-coast as far as Port Fairy. Small patches of the newer volcanic and large areas of the "older" volcanic are scattered through Gippsland and the North-Eastern District. The general aspect of the newer volcanic region is a fairly level plain, with the well-known rounded or conical hills at frequent intervals. In the Western District its average elevation is about 400 feet above the sea, and it gradually rises to a height of from 1,200 to 2,000 feet as it ascends the slope of the central hills.

Fifth, the Mallee, the north-western extension of the Northern Plain, originally, no doubt, level and uniform in appearance, but now it has been drifted by the wind into long undulations and abrupt sand dunes.

The following tables give the results of the analyses of 185 samples of Victorian soils, which have been made in the laboratory of the Department of Agriculture since 1902. They are arranged in the five classes into which we have divided the soils according to the physical features of the country. No attempt has been made to place the hill soils, or those of the southern plain, in their respective geological formations, as this information was not always forthcoming. In some cases the hill soils are more properly alluvial, as they have been taken from the corresponding valleys. The soils of each group are arranged in order from east to west. For purposes of comparison typical average results are appended, comprising :—

(1) English soils (Hall, on the Soil).
(2) American soils (Hilgard and King).
(3) South Australian Mallee (Pinnaroo Railway Report).
(4) Werribee Park soils (Nos. 186-9), made in London by Dr. J. A. Voelcker.

The numbers in the table may be changed into percentages by placing the decimal point in front of the third figure, supplying this figure by 0 when only two are given. Thus:—

2,840 parts per 100,000 equals 2.840 per cent.
105 parts per 100,000 equals .105 per cent.
25 parts per 100,000 equals .025 per cent.

While the weight of soil varies considerably according to the texture, on the average it may be assumed that 10 parts per 100,000 are equivalent to 3 cwt. of the corresponding ingredient in the surface foot of every acre of land.

In calculating the averages, abnormally high amounts of any constituent have been discarded. For example, No. 132, containing 44 per cent. of lime, and No. 158, from the edge of a salt marsh, would have unfairly raised the average, as they are representative of only small areas. Figures treated in this way are enclosed in brackets. It will be seen that there are great variations in the samples from adjacent localities, so that while the averages of three or four samples may be taken to represent the amount of plant food in the soil of any given farm, it is not safe to extend this generalization over any wide area. The averages might easily be altered by including more of the richer or poorer soils respectively, but it is believed that the samples given fairly represent the average of each class of soils. As far as possible examples of the richest and the poorest land have been included in numbers proportional to the respective areas. In the case of the Mallee, a sufficient number of analyses have not yet been made to enable this to be done, and we have therefore included some samples of the richer and poorer parts of this country, situated at a short distance from the Victorian border. In every case it may be assumed that the soil from a valley is richer than that from the adjacent hill.

ANALYSIS OF VICTORIAN SOILS (PARTS PER 100,000).

I.—HILL SOILS (MOSTLY CLAY SOILS).

—	Soil.					Subsoil.				
	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.
1. Yackandandah ..	87	55	228	228	4	..	..	..	..	..
2. Stanley Forest ..	112	73	160	94	4	69	53	293	90	7
3. ,, ..	70	212	335	309	9	64	209	252	226	8
4. ,, ..	74	56	138	80	9	96	44	181	66	6
5. ,, (Granite)	63	50	117	150	4	76	49	267	72	8
6. ,, ,,	82	62	350	352	10	50	72	449	234	9
7. Strathbogie ..	168	60	288	237	9	..	..	..	..	..
8. Cathkin	93	80	345	130	4	191	136	579	390	6
9. Whittlesea ..	188	43	148	126	(460)	240	83	184	272	(68)
10. Diamond Creek ..	97	28	131	74	5	49	31	439	59	6
11. Kinglake	286	84	297	340	8	..	..	..	..	..
12. ,, ...	201	52	384	170	11	..	..	..	..	..
13. ,, ...	193	45	172	146	18	..	..	..	..	..
14. Kangaroo Grounds ..	57	22	194	69	6	..	..	..	..	..
15. Greensborough ..	189	53	519	52	21	..	..	..	..	..
16. Bayswater ..	151	20	50	180	9	93	22	47	4	10

I.—HILL SOILS (MOSTLY CLAY SOILS)—*continued.*

—	SOIL.					SUBSOIL.				
	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.
17. Bayswater ..	141	29	65	116	9	110	25	77	9	12
18. Hastings	148	25	61	296	6	90	25	71	342	3
,, (under sub-soil)	..	..	..	..	..	50	39	117	146	12
19. Toora	245	33	140	105	9	107	27	233	78	10
20. Fish Creek.. ..	161	67	190	102	5	138	60	245	128	5
21. Bena	252	204	550	660	36	161	176	472	444	27
22. Beech Forest ..	117	27	216	49	5	..	..	..	..	..
23. Trentham	167	112	183	246	7	103	123	201	444	7
24. Muckleford ..	224	34	150	115	15	..	..	..	..	..
25. Bendigo	114	74	170	96	9	51	29	98	44	10
,, (under subsoil)	..	..	..	..	..	61	30	386	46	10
26. Stawell	425	92	361	394	80	..	..	..	..	..
27. Grampians.. ..	66	20	29	66	4	66	23	54	40	5
28. ,, ...	73	20	45	61	2	44	26	44	27	5
29. ,, ...	193	123	98	173	6	196	121	188	100	5
30. ,, ...	55	33	41	78	2	..	..	..	..	..

II.—THE NORTHERN PLAIN.

—	SOIL.					SUBSOIL.				
	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.
31. Corryong	246	159	315	586	27	137	79	207	195	8
32. Moyhu	58	27	45	154	3	..	..	..	..	..
33. Wangaratta ..	372	144	373	79	49	138	161	385	54	93
34. Benalla	130	50	128	238	3	..	..	..	..	..
35. Dookie	67	58	385	140	7	..	..	..	..	..
36. Shepparton ..	71	64	240	675	6	34	19	527	361	5
37. Mooroopna ..	156	76	288	320	8	..	..	..	..	..
38. Nathalia	112	71	269	207	4	..	..	..	..	..
39. Tatura	112	49	211	320	7	..	..	..	..	..
40. Rushworth ..	140	48	330	403	4	..	..	..	..	..
41. Wanalta Plain ..	94	55	235	135	6	..	..	..	..	..
42. Derrinal	72	31	122	65	4	..	..	..	..	..
43. Wyuna	91	56	299	168	9	..	..	..	..	..
44. ,, ...	99	46	303	113	8	..	..	..	..	..
45. ,, ...	84	53	505	296	12	..	..	..	..	..
46. Echuca	172	50	264	258	8	64	43	545	296	16
47. Goornong	81	61	116	256	9	..	..	..	..	..
48. Eaglehawk ..	230	83	181	384	5	..	..	..	..	..
49. Cohuna	93	56	275	364	14	..	..	..	..	..
50. Kerang	..	70	830	410	3	..	..	..	..	..
51. ,, ...	..	80	580	3,520	25	..	..	..	..	..
52. Buckrabanyule ..	140	57	528	5,010	5	80	55	356	1,515	8
53. Wedderburn ..	82	21	253	127	7	..	..	..	..	..
54. Majorca	90	73	263	155	2	..	..	..	..	..
55. Bung Bong ..	125	72	272	743	5	..	..	..	..	..
56. Donald	150	44	1,170	3,490	7	..	..	..	..	..
57. ,, ...	99	79	564	648	2	85	22	814	605	2
58. Birchip	90	26	153	190	17	..	..	..	..	..
59. Swan Hill ..	70	52	553	458	3	..	..	..	..	..
60. Horsham ..	96	90	803	1,180	7	75	67	781	1,370	9
61. ,, ..	166	64	2,075	1,840	12	84	68	1,975	8,345	40
62. Natimuk ..	120	60	838	5,995	3	108	27	771	9,650	5
63. Arapiles	67	50	503	7,380	4	..	..	..	..	..
64. Nhill	32	25	90	150	20	..	..	..	..	..

III.—THE COASTAL PLAIN.

—	Soil.					Subsoil.				
	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.
65. Bruthen	184	6	70	267	24	89	5	65	95	61
66. Swan Reach ..	232	69	325	467	2	..	..	..	..	..
67. Tambo	87	42	87	215	3	67	44	220	120	8
68. Bairnsdale ..	398	267	284	376	5	272	299	367	308	6
69. ,, ..	164	89	215	345	19	..	..	..	..	..
70. Briagolong ..	216	136	621	362	1	120	79	367	224	1
71. Boisdale	399	241	391	404	8	134	29	390	28	5
72. Newry	238	99	525	272	4	106	79	189	180	6
73. ,, ...	92	136	533	400	6	84	58	313	180	4
74. Maffra	112	64	201	200	6	76	45	663	92	2
75. Upper Maffra ..	194	141	400	348	2	92	100	346	278	5
76. Sale	469	244	778	608	2	144	112	636	240	11
77. ,, ...	136	95	483	215	5	223	70	705	213	6
78. ,, ...	350	147	417	356	4	130	72	382	180	15
79. Rosedale	163	78	180	160	8	197	80	159	180	11
80. Welshpool ..	141	16	83	60	8	48	7	119	27	113
81. Crossover ..	216	62	138	92	7	56	66	105	328	12
82. Traralgon ..	366	126	298	1,123	18	186	111	280	99	8
83. Morwell	448	103	242	286	13	133	48	135	182	7
84. Trafalgar ..	314	65	130	296	8	48	18	66	124	7
85. ,, ...	139	29	58	62	30	64	22	46	40	16
86. Darnum	143	35	55	60	4	..	..	..	..	..
87. Drouin	250	22	76	190	4	87	20	86	158	4
88. Longwarry ..	182	22	65	96	3	..	..	..	..	..
89. Bunyip	29	15	65	84	4	22	7	70	40	4
90. ,, ...	184	34	59	32	18	..	..	..	..	..
91. Narre-Warren ..	60	19	61	73	5	61	45	182	57	5
92. Powlett River ..	199	66	168	152	8	171	98	160	244	8
93. Oakleigh	64	18	71	68	3	..	..	..	..	..
94. ,, ...	240	26	70	75	4	25	10	50	50	4
,, (under subsoil)	..	..	..	..	..	14	10	50	65	4
95. Spring Vale ..	150	20	45	80	5	84	17	52	63	3
,, (under subsoil)	..	..	..	..	..	53	23	28	55	3
96. Caulfield ..	178	82	87	502	5	50	48	57	128	5
97. Brighton ..	104	38	80	170	2	70	45	225	260	4
98. ,, ..	71	38	97	288	2	86	24	364	363	2
99. ,, ..	90	38	301	200	3	90	28	253	220	2
100. South Brighton ..	185	20	28	150	6	300	46	210	320	4
101. East Brighton ..	190	40	62	200	2	300	55	47	300	230
102. Carrum	104	100	291	600	62	..	..	..	..	..
103. ,, ...	87	70	204	600	(390)	..	..	..	..	..
104. ,, ...	102	80	168	590	20	..	..	..	..	..
105. ,, ...	187	25	75	140	9	..	..	..	..	..
106. Lyndhurst ..	249	62	137	458	29	..	..	..	..	..
107. ,, ..	138	35	76	137	10	..	..	..	..	..
108. ,, ...	57	22	62	80	5	..	..	..	..	..
109. Cranbourne ..	114	23	33	68	4	..	..	..	..	..
110. Frankston ..	56	22	25	84	10	73	13	13	72	8
111. Mornington ..	147	12	61	56	4	79	14	208	60	7
112. ,, ..	84	17	150	116	9	89	19	178	76	12
113. Langwarrin ..	75	29	138	56	6	62	28	249	64	7
114. ,, ..	114	33	173	36	5	61	23	231	40	7

III.—THE COASTAL PLAIN—*continued.*

—	Soil.					Subsoil.				
	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.
115. Langwarrin ..	77	36	59	28	20	35	18	74	20	2
116. Somerville ..	231	36	98	110	5	105	22	77	62	4
117. Dromana ..	140	22	59	83	..	37	9	42	23	2
,, (under subsoil)	..	..	..	..	..	48	11	137	65	10
118. Bittern	246	21	46	102	..	..	..	..	..	..
119. ,, (hill) ..	73	5	25	59	..	..	..	..	..	..
120. Bacchus Marsh ..	179	44	439	280	4	155	39	528	352	14
121. Lara	102	29	250	145	20	40	38	512	3,002	141
122. Geelong	152	83	323	296	4	129	70	606	319	7
123. Connewarre ..	100	36	273	610	2	81	29	476	377	8
124. Barwon Heads ..	74	20	64	153	2	30	21	53	154	2
125. ,, ..	78	30	93	362	3	21	9	75	144	2
126. Airey's Inlet ..	101	27	65	117	6	93	32	162	125	11
127. Ceres	145	49	305	285	40	113	47	653	308	20
128. German Town ..	78	21	70	1,602	6	71	21	208	66	26
,, (under subsoil)	..	..	..	..	..	28	12	31	58	7
129. Herne Hill ..	190	41	320	640	2	75	19	521	726	2
130. Moolap	178	48	611	998	..	40	80	1,414	193	..
,, (under subsoil)	..	..	..	..	..	34	33	392	172	..
131. ,, ...	132	63	356	325	4	85	60	884	285	15
132. Cowley's Creek ..	350	70	79	(44,020)	2	130	60	75	(43,900)	4
133. ,, ..	233	75	230	2,000	13	137	50	210	(11,700)	11
134. ,, ..	155	34	230	960	10	100	31	225	790	3
135. Timboon ..	264	110	380	2,280	4	166	70	383	1,800	5
136. ,, ..	302	170	211	(26,750)	5	184	110	241	(27,720)	5
137. ,, ..	268	115	210	(26,405)	7	198	19	188	(30,400)	12
138. Heytesbury Forest	177	12	17	66	9	110	13	23	27	5
139. ,,	228	23	40	90	7	99	22	70	32	5
140. ,,	103	25	20	52	8	90	24	33	48	7
141. Allansford ..	248	85	89	328	1	67	37	71	148	1
,, (under sub-soil)	..	..	..	..	..	70	52	180	164	3
142. ,, ...	148	43	41	150	3	73	34	70	120	2
143. ,, ...	164	42	73	136	1	45	21	82	69	1
144. ,, ...	166	30	70	173	1	32	9	55	56	1
145. Allansford ..	171	45	94	133	1	65	26	238	163	1
146. Yambuk	198	86	152	255	3	124	75	253	239	2
147. ,, ...	355	185	304	680	5	147	115	482	494	5
148. ,, ...	160	98	148	226	3	92	77	176	220	3
149. ,, ...	193	64	436	694	8	95	70	394	294	10

IV.—VOLCANIC SOILS.

150. Balnarring ..	120	8	48	88	5	81	16	51	216	6
151. Fingal	227	68	82	964	4	154	70	72	574	3
,, (under subsoil)	..	..	..	..	..	95	28	50	(25,260)	3
152. Geelong North ..	259	45	324	987	7	119	50	449	948	6
153. Colac	138	46	169	95	2	85	44	172	106	2
154. ,, ...	110	38	92	97	2	18	25	77	42	3

IV.—VOLCANIC SOILS—*continued.*

—	SOIL.					SUBSOIL.				
	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.
155. Colac	130	40	91	122	3	23	19	62	48	4
,, (under subsoil)	..	..	..	..	..	73	47	349	158	7
156. ,, ...	151	34	100	86	9	40	12	97	32	2
,, (under subsoil)	..	..	..	..	..	64	20	295	115	3
157. Beeac	64	33	81	57	2	..	..	..	..	..
158. Eurack	214	68	176	839	(930)	..	..	..	..	..
159. ,, ...	131	36	400	112	(954)	..	..	..	..	..
160. Camperdown ..	691	42	187	222	11	19	28	192	15	5
161. Terang	144	24	277	268	16	..	..	..	..	..
162. Noorat	219	119	304	2,547	6	..	..	..	..	..
163. ,, ...	241	39	160	160	15	119	75	235	127	12
164. Framlingham ..	378	79	304	1,758	18	175	74	333	1,118	36
165. Panmure	279	52	98	170	4	138	56	122	96	6
,, (under subsoil)	..	..	..	..	..	50	50	104	56	3
166. Cudgee	309	51	119	366	2	196	49	132	352	3
167. Narringal ..	373	108	99	208	5	248	49	142	360	6
168. ,, ..	274	75	50	133	4	155	44	122	58	3
169. Warrnambool ..	494	137	2,016	1,944	..	..	..	..	..	..
170. Croxton West ..	378	41	401	632	102	..	..	..	..	..
171. ,, ..	322	136	316	426	60	..	..	..	..	..
172. ,, ..	718	104	445	684	78	..	..	..	..	..
173. ,, ..	275	41	216	251	54	..	..	..	..	..

V.—MALLEE SOILS.

174. Mildura	185	53	506	3,605	7	..	..	..	..	..
175. ,, ...	50	70	480	560	5	30	30	930	1,420	7
176. ,, ...	30	60	490	1,160	2	20	40	750	3,840	4
177. Brim	110	36	368	750	12	..	..	..	..	..
178. Galaquil	190	23	57	56	12	..	..	..	..	..

VI.—DRAINED SWAMPS.

179. Moe	602	198	395	372	14	672	159	356	421	56
180. Bunyip	913	112	173	364	16	462	45	143	228	12
181. French Island ..	691	31	73	419	59	193	27	66	128	22
182. ,, ..	498	23	124	121	36	..	..	..	..	..
183. Corinella	1,410	43	23	230	76	..	..	..	..	..
184. Heifer Swamp ..	1,330	79	568	444	88	204	19	666	196	62
185. Bendigo	280	51	330	210	17	..	..	..	..	..
186. ,, ...	277	70	420	360	17	..	..	..	..	..

VII.—WERRIBEE PARK.

Analysis by Dr. J. A. Voelcker, London.

187. Werribee Park ..	110	80	340	170	12	..	..	..	..	..
188. ,, ..	120	80	340	200	17	..	..	..	..	..
189. ,, ..	200	80	..	300	..	..	..	..	..	..
190. ,, ..	130	130	290	400	28	..	..	..	..	..

VIII.—MALLEE SOILS (*South Australian Analyses.*)

—	Soil.				
	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.
Good mallee, black soil	105	27	...	1,270	
Red sand, pines, oaks, and acacias	36	15	...	Trace	
Good loam on limestone rubble	97	25	...	2,840	
Light loam, carries average mallee	59	15	...	1,740	
Light soil, carries black mallee	80	15	...	4,580	
Good loam, carries large mallee	97	25	...	2,840	
Deep red sand in ridges, covered with cutting grass	60	15	...	1,820	
Sand, carrying stunted mallee, broom, and low bush	27	Nil	...	Nil	
IX.—ENGLISH SOILS, TYPICAL ANALYSES. (*Hall.*)					
London clay (heavy arable land)	276	120	1,130		
Gault clay (heavy pasture land)	226	92	968		
London clay (arable loam)	187	65	330		
Chalk (arable calcareous loam)	194	94	460		
Millstone grit (arable light loam)	171	88	207		
Red sandstone (arable sandy loam) ...	207	59	295		
Hythe beds (arable light loam)	180	210	640		
Thanet beds (arable sandy loam)	120	95	354		
Lower green sand (arable sand)	110	150	220		
Bagshot beds (waste sand)	80	13	32		

X.—AVERAGES.

—	Soils.					Subsoils.				
	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Chlorine.
Clay Soils (30)	149	63	205	176	10	100	66	232	155	8
Northern plain (34) ...	112	61	422	1,072	9	89	60	706	2,487	20
Coastal plain (85) ...	178	61	185	903	7	106	46	247	380	13
Volcanic (24)	272	61	277	588	17	103	42	170	1,649	6
Mallee (5)	113	47	380	2,426	7					
Drained swamps (8) ...	750	76	263	315	40	191	31	154	121	19
England, typical soils (10)	175	98	463							
American, arid (466) ...	...	117	729	1,362						
,, humid (313) ...	...	113	216	108						
,, sand ...	...	128	157	115	...	...	124	143	96	
,, clay ...	...	207	214	1,761	...	...	159	344	1,481	

HILL SOILS.

Geologically these areas consist of very ancient rocks, granites, slates, sandstones, &c., except where they have been covered with basalt and ashes from the volcanoes. In the latter case the soils are included with Class IV. Nos. 5, 6, 7 are from granite ranges; 19, 20, 21, 22 from

Gippsland and Cape Otway hills, of Mesozoic age; 27, 28, 29, 30 from the foot of the Grampian sandstone ranges, and the remainder from the slates and softer sandstones (Ordovician and Silurian) found in the goldfields.

The appearance of the hill country varies with the hardness of the rock and the amount of weathering. As a rule the country to the east of Walhalla and Mansfield is much more precipitous than that to the west, with the exception of the Grampians. As a rule these soils are poor in nitrogen and lime, but well up to the average in phosphoric acid and potash. Their subsoils are the richest of all in phosphoric acid, and are well supplied with the other constituents. In addition, both the surface and subsoil hold the water well, and these soils suffer less from drought than any other type. As will be seen from Tables IX. and X. in England and America, clay soils are looked upon as the most valuable of all. Phosphoric acid, the controlling factor in the development of plant life, is here found in its native home. Originally all the phosphoric acid of the soil formed part of the most ancient rocks, and, as will be seen later on, it has been gradually concentrated on the surface by the intervention of animal life. The greater part of this area in Victoria is still heavily timbered, but where clearing has taken place marked improvement in the pastures has already taken place. Almost without exception this type forms good fruit-growing land.

Nearly all these areas are characterized by the well-marked clay subsoil that they contain. Very frequently the surface 6 inches or a foot is cemented into a fairly hard and impervious surface, but as soon as the subsoil is exposed it is seen to be much more friable and open in texture than the surface. This is typically seen in many of the shallow cuttings and water drains along the roads, and also at the bottom of deep ruts formed by the wheels over bush tracks. All this country lends itself readily to improvement. It may be hungry and cold at first, but the soil retains anything that may be added to it, whether in the form of farm-yard manure or artificial fertilizers, while the subsoil is a great reservoir of moisture all through the summer. The forests which cover these areas in all parts of Victoria are sufficient evidence of the capabilities of the clay soils when things once start to grow. At first when brought under cultivation, there is much trouble from the clods, but as the soil becomes traversed in all directions by the roots of the crops, this tendency becomes less, and the whole soil becomes mellow and loamy. The bits of slate and quartz fragments which are found in many parts rather improve the texture by preventing the formation of clods. If possible, the paddock should be cross-ploughed each time it is broken up, and the general rule may be laid down that 100 lbs. of superphosphate should be added with each crop.

Many soils of this character, poor third class land, according to the general opinion, are wonderfully improved by the above treatment and by subsoiling. In the latter case, however, the clay must not be turned up to the surface, but a second plough should follow the first in the bottom of the furrow, or a heavy scarifier used in the winter, and the necessity of drainage must not be forgotten.

THE COASTAL PLAIN.

The soils of the Coastal plain differ more in average composition than those of any other class. As they become more distinctly alluvial in character, and particularly as we approach the lower levels of rivers and creeks, the amount of nitrogen steadily increases, until they approach more nearly the character of swamp soils. Nos. 68, 72, 78, and 83 may be quoted as examples. The extremely rich river flats of Gippsland, where the fertility of the soil, conjoined with the heavy rainfall, enables all kinds of summer crops to be grown to perfection, are seen in Nos. 70, 71, and numerous other examples. It will be seen that the drained swamps of West Gippsland are well supplied with nitrogen, but are deficient in phosphoric acid and potash (Nos. 82 to 91). The poorer soils of this group are the light sands and sandy loams to be found to the south-east of Melbourne, extending from Caulfield to Mordialloc (Nos. 93 to 101). The average amount of phosphoric acid which they contain is decidedly low, while the potash and nitrogen are considerably less than the average of all soils of this type. Numbers 124, 125, and 126 to the south-east of Geelong are sandy soils of essentially the same class. Farther west Nos. 132 to 140 constitute a group taken from the Heytesbury Forest. It will be seen that those from the limestone country appear amongst the richest soils of this group, while the numbers 138, 139, and 140 from the Grass Tree country are well above the average with regard to nitrogen, but deficient in phosphoric acid and potash. The remaining soils of this group (141 to 149) are good examples of alluvial soils of more than average fertility from the edge of the volcanic country of the Western District.

Alluvial soils vary much in character in accordance with the distance they have been transported and the character of rock from the disintegration of which they were originally formed. The further the materials have been carried by the action of the water or the wind from their original position the finer they become. There is marked difference in the condition of the materials which result from various rocks; thus, granites and sandstones usually produce fairly coarse-grained soil, on account of the amount of quartz and other hard materials which they contain. Soft slates, on the other hand, rapidly weather down into very fine-grained soil, in some cases containing hardly any gritty material at all. Owing to the fineness of the particles of most of the alluvial soils, natural vegetation, both in the shape of grasses, shrubs, and trees, is always obtained provided there is a sufficient rainfall. As these soils have been slowly built up by the accumulation of material in successive ages, they become denser as we pass from the surface downwards, till they ultimately assume the condition of clay, unless the whole depth of material is composed of sand. We therefore very frequently find that alluvial soils present a surface soil of variable depth, passing gradually—first into a clayey loam, and then finally into a well-defined clay. The proportion of sand in the soil steadily increases as sandstone rock is approached, and the same fact holds good also of the soils which have resulted from the action of the sea. In the latter case, limestone has often been formed from the sea water by the ceaseless energy of marine animals. Hence, in the case of the northern plains, we find a considerable amount of the sandy admixture in the soils to the north and north-west of Wangaratta, to the south of Longwood, and around Pyramid Hill, where the granite has formed the material of which they were originally composed. Similarly, the hard sandstones of the Grampians have been responsible for the sandy country between the foot of the ranges and Goroke. On the south coast very extensive areas of sandy country are found between Portland and Port Fairy, and to the south and east of Sale, areas which correspond with a section of the highlands of Victoria, characterized by exceedingly hard rocks. Where the alluvial soil has been formed by the disintegration of volcanic rock, and particularly where it has been formed from a mixture of different kinds of rocks, it is generally found that it is exceptionally fertile. An example of this is seen in the case of the river flats of the Snowy. This river traverses almost every variety of rock—granite, crystalline, slate, limestone, and ancient and modern volcanic. The resulting soil is an unusual mixture of very fine and rather coarse material, frequently glittering with particles of mica, showing no tendency to clod when it becomes saturated with water, and allowing the roots of the plants facilities for penetrating to a great depth.

The amount of vegetation which has been growing on alluvial soils during past ages also has considerable influence in modifying their character. Most swamp lands, when they are drained, are particularly rich, the amount of nitrogen that they contain being especially high. These characteristics are due to the fact that they are largely formed of the decomposed remains of countless generations of plants.

THE NORTHERN PLAIN.

The soils in the Northern plain, with the exception of Nos. 31 and 33, are much more uniform in their character than those of any of the other classes. No. 31 is an example of an extremely rich black alluvial soil from one of the tributaries of the Upper Murray; No. 33, an equally rich example from the valley of the Ovens. It will be seen that with these exceptions no other sample of Northern soil contains as much as .1 per cent. of phosphoric acid, but they are well supplied with potash and, for the most part, abundantly supplied with lime. The average amount of lime seems to rise steadily as the samples are taken from east to west, particularly when there is high ground within a distance of 20 or 30 miles. Nos. 51, 52, 62, and 63 may be cited as examples. The few analyses of subsoils that have been made seem to indicate that phosphoric acid is somewhat less abundant, while potash and lime are in considerably larger proportions than is the case with the surface foot. The abundance of lime in the soil around Horsham and Natimuk accounts for the way in which these heavy black soils break into a friable tilth as they become dry, although their appearance when saturated with moisture in the winter would lead to the opinion that they are difficult to work. The amount of nitrogen in these soils, though not so constant as the percentage of phosphoric acid, is still remarkably uniform.

In dealing with the Northern plains we naturally seek for an explanation of the great differences of vegetation between the timber country and the open plains. Chemical analysis offers very little to guide us here. Nos. 43, 44, and 45 are from the same parish, and No. 45 especially selected as being a typical example of the scorched, bare, plain, absolutely destitute of vegetation, yet with the exception of a little less nitrogen it appears to be a richer soil than either of the other two. While not prepared to say that there is no difference between the one class of soil and the other, it is well to point out that where the scorched plains have been cultivated with the use of superphosphate, and particularly where they have been watered, all the apparent differences between the bare and the timbered country rapidly begin to disappear. It will be noted that as the edge of the Mallee is approached (Nos. 58, 59, and 64), the percentage of phosphoric acid diminishes as well as the amount of nitrogen.

A reference to the preceding table will show that while the northern soils vary in character, they are generally fairly supplied with nitrogen, are rich in potash and lime, but deficient in phosphoric acid. After the timber has been ringed a good growth of nutritious grass speedily appears; and these soils have always been famed for the way in which they will fatten cattle and sheep in a good season. They are usually easily worked, and yield good returns of wheat and oats—the amount of the return being controlled by the rainfall, and, at the present time, the application of phosphoric acid. On the average, it is found that ½ cwt. of superphosphate, averaging 20 per cent. available phosphoric acid, gives the best paying returns. A lighter dressing causes a diminution of 2 or more bushels per acre, while a heavier dressing seems to be dependent upon the amount of moisture available in producing any increase sufficient to warrant the additional expenditure. Where the northern soils are clayey in nature, they give much less trouble than the silurian clays in cultivation, for two reasons: in the first place, the large proportion of lime present keeps them friable, and, secondly, the quantity of stubble and other material which is produced during a good season keeps up the amount of humus in the soil, and so again prevents them from caking. It is found that clods are much more troublesome in paddocks that have been burnt off for several years in succession than in any other part of the north—a "burn-off" directly reducing the amount of humus in the ground.

VOLCANIC SOILS.

Contrary to the usual opinion, chemical analysis reveals very little to indicate the superior fertility of the volcanic land. On the average, while these soils contain decidedly more nitrogen, they are exactly equal to the others in phosphoric acid, and very little richer with regard to potash. It is interesting also to note that the subsoils show a marked falling off in each of these three constituents, and a large increase in the amount of lime. Even where these soils are taken from some of the best localities in the Western District (Nos. 162, 167, 169, and 171), they do not exhibit any very great amount of plant food when compared with the best of the alluvial flats from other parts of Victoria. Yet experience proves beyond question that, taken as a whole, the volcanic soils are much above the average in fertility. Frequently a little isolated patch of soil of this character is locally known as the "green hill," or by some equally characteristic title. The explanation which must be given can only be that what food materials are present in these soils are more readily available for the plant than is the case in most varieties of land. While the harder volcanic rocks may not yet have had time to weather down into a friable soil, there are dust and ashes which are continually being ejected from volcanoes even in periods of comparative quiescence. These materials very soon become available for the purposes of the plant, and it is significant that in the majority of our extinct volcanoes the richest land is found in the sphere of influence on the eastern half of the circumference. If this generalization be correct, it indicates that the prevailing winds have carried the finer materials away from the west. The subsoil is usually markedly inferior to the surface soil.

The volcanic soils vary in type not only in different districts, but also with regard to the materials discharged from any given centre of eruption at different periods of activity. The same thing is going on at Vesuvius at the present time, where some of the ash beds become covered with luxuriant vegetation in a few generations, while other tracts are as barren of it as they were 1,000 years ago. Generally speaking, the older volcanic soils, as found round Warragul, Narracan, Leongatha, and other parts of Gippsland, have weathered into extremely rich soil, the general result, as far as fertility is concerned, being influenced to a large extent by the heavy rainfall of these districts. In the much older volcanic soils of Gembrook, Healesville, Macedon, Mansfield, and East Gippsland districts, the depths and fertility of the chocolate soils are well known, but there is probably in most of these localities a larger proportion of hard and intractable rock than in the case of the localities mentioned in South Gippsland.

Speaking as a whole, volcanic soils are greatly modified in value by the proportion of rock which is present, and its proximity to the surface. Some areas, as, for instance, the Stony Rises to the west of Colac, have the rock in large areas very close to the surface. In places, as Koroit, we find examples of the soil having been formed of mud and ashes 50 or 100 feet in depth, while over very large areas, though rocks are met with, the characteristic appearance of the soil is a yellow or grey loam intermixed with small particles of rounded ironstone, which go by the name of buck shot. In all cases the different results obtained from volcanic land and that which we have just been considering are explainable more by the absence of subsoil than by anything else. It is very seldom, in volcanic areas, that any clay can be obtained which is good enough to make into bricks. The consequence is that such soils dry out readily in summer, while, on account of the generally level nature of the country, and the frequent presence of crabholes, it is not unusual to find that volcanic land is very wet in the winter. Where the soil is above the average of fertility, there is so much plant food available that ordinary dressings of artificial manure make practically no difference whatever in the yields. On the other hand, a free application of farm-yard manure, and the ploughing in of stubble and other vegetable refuse, almost invariably improves the soil, simply because it increases its water-holding capacity. In many of the chocolate soils the absence of the subsoil is a matter of comparatively little importance, because the rainfall is so heavy that these areas seldom become affected by the drought, even at the end of summer. Such areas form the typical fruit-growing lands of the mountain ranges. On the other hand, at Melton and to the north of Colac, extremely rich soils are found which suffer from the effect of the scanty rainfall; and such soils lend themselves to rapid improvement by the use of farm-yard manure or its equivalent. The absence of clay prevents most of the volcanic soils from puddling and setting into hard clods. Even when they are dry they remain friable, and this undoubtedly is one of the reasons why volcanic land has been selected as the favorite potato and onion growing districts in the State. In the case of the large area of land extending northwards from Melbourne through Leigh Road and on to the foot of the Grampians, the soil is mainly of the grey and brown variety already mentioned, and in its natural condition such soil is not particularly rich. The addition of from ½ to 1 cwt. of superphosphate to the acre seems to be all that is required in order to bring out its latent possibilities; and as these districts receive a rainfall of from 20 to 25 inches, and the loamy soil is easily worked, it will be readily understood why this area has come to be looked upon as the future centre of wheat growing in Victoria.

COMPARISON WITH OTHER SOILS.

Judged by European and American standards, many of the samples of soils included in the foregoing tables would be considered poor, especially in regard to phosphoric acid and lime. For instance, Bagshot is described as waste sand, yet it is not unlike much of the land used for intense culture around Melbourne, or if located in the Mallee it would doubtless produce very remunerative crops of wheat. That phosphoric acid is the most prominent deficiency in Australian soils is a well-known fact, but perhaps a more remarkable fact is the very small amount of this substance which has to be supplied in order to produce the maximum crop that the moisture available will bring to maturity. Eighteen bushels of wheat is not a bad average for a rainfall varying from 14 to 20 inches. This is the average on 23 experimental plots with the use of 10 lbs. of phosphoric acid per acre (representing 56 lbs. of superphosphate). The average crop in the United States is 13, and in Canada 19 bushels per acre. The apparently poor wheat soils of Victoria therefore give remarkably good yields. The same remarks apply with even greater force to the light sandy soils of the south.

It is often asked if there is not a certainty in the early future that such soils will become exhausted of their supply of plant food, and become unprofitable. So long as live stock are kept in considerable numbers, this is not likely to happen. I take it that Australian soils owe their small phosphoric acid supply to the fact that the continent has never been heavily stocked by large animals of any kind. In Victoria we know that previous to settlement by white men the number of kangaroos and emus was much less than the number of sheep is at present. Periodical droughts reduced them in the north; vast areas were so densely timbered that there was little herbage for them to eat. There were never very many natives in Victoria, but there were quite enough to keep the large animals from becoming numerous on the open plains. Now the animal is the great factor in concentrating phosphoric acid in the surface layers of the soil. It is true that where no animals are present nearly all the components of the plant are returned to the soil by the process of decay. But the animal stimulates the plant to increased growth. As the flower shoots in particular are browsed off, fresh efforts are made to produce a new crop of seed. Hence more phosphoric acid is drawn up by the roots from the deeper layers of the soil. The animal concentrates the phosphates chiefly in the bones, and when death occurs the bones are slowly but surely incorporated in the earth. In addition, phosphates are being continually returned to the soil in the excrements. The carcass of one sheep to the acre represents the application of 2 lbs. of phosphoric acid, or about 10 lbs. of ordinary superphosphates. This quantity does not appear very large, but when the process is repeated year by year for centuries the amount steadily accumulates. As phosphoric acid becomes available in increasing quantities the growth of plants of all kinds is stimulated, and consequently more animals can be carried in a given area. Nature's methods throughout all bygone ages are precisely what every thoughtful farmer aims at imitating at the present day. Just as living plants and animals have slowly accumulated the potash and lime from the sea water till they form vast masses of dry land, so the nitrogen and phosphoric acid have been gradually made available for existing plants and animals by their predecessors throughout all the geological ages. The soils of Victoria are just beginning to be improved by animals. The transformation of the hill country, which is brought about by the introduction of Merino sheep, may be studied about Alexandra or Tallangatta, where a few years have already made great changes. Judging by what has already occurred, I think we may have no misgivings for the future.

SUMMARY.

The average chemical composition of Victorian soils as taken from the preceding tables bears out the inferences drawn from the examination of soils of various localities. Judged by European standards the amount of fertility is often small. When it is attempted to make an estimate of the amount of plant food in readily available form (soluble in water or citric acid solution), the results are very disappointing. Yet the practical results are precisely the opposite, and it may well be doubted if any soil in the world is more prolific. The total amount of agricultural products consumed locally and exported is valued at over £20,000,000, or an average production of nearly £400 per farm. As only one acre out of every eight of the occupied part of Victoria is at present under cultivation, the above results are achieved to a very large extent simply by grazing the natural pastures. The soils from Mildura (Nos. 174-176) are much below the average in phosphoric acid and nitrogen, yet under irrigation 10,000 acres support a population of 5,000, or 330 persons to the square mile. Here again development is just beginning, for with the application of more labour the returns from the irrigated land could be vastly increased. From the strictly chemical point of view Werribee land appears to be in danger of early exhaustion, yet after many years of grazing and cropping it is more valuable than ever. Similar instances could be quoted from every part of the State.

Reverting to the total weight of each ingredient present in the surface foot of each acre (p. 31), it will be seen that No. 21 contains in this amount of soil 3¾ tons of nitrogen, 3 tons of phosphoric acid, and 8¼ tons of potash. No. 27 (one of the poorest) contains 1 ton of nitrogen, 6 cwt. of phosphoric acid, and 9 cwt. of potash. As a 20-bushel crop of wheat (straw and grain) removes only 35 lbs. of nitrogen, 14 of phosphoric acid, and 25 of potash, it will be seen that even poor soil contains materials for generations of cropping if the proper ingredients can only be made available. The phosphoric acid would last about 48 years. There is, however, the subsoil to draw on, and we have seen that phosphoric acid is nearly as abundant in the subsoil as in the surface. With intelligent farming there is no question but that the amount of plant food will steadily increase. The striking results produced by the application of 10 lbs. of phosphoric acid in the form of super-phosphate has been already referred to. Such a small amount cannot perceptibly increase the total per acre. At the most, it can only give the young plants a good start, because from what we know of the residual effects of such applications, it is fairly certain that the whole of the added phosphoric acid is not absorbed by the growing crop. There must, therefore, be certain changes going on in the soil during the growth of the crop which rapidly render the latent plant food available. What these are we are not in a position at present to state precisely. The marvellous growth that occurs everywhere when the rain comes after a dry spell shows that there are forces at work during the months of bright sunshine which are very friendly to the husbandman. The fact that applications of nitrogen actually reduce the yield in the northern plains confirms this view. Many acres of the poor sandy soils (Nos. 93 to 101) are bought and sold at from £20 to £40 per acre, after they have been under cultivation for a few years, and where such improvement is daily taking place, it is certain that it will follow on the same methods being applied to more remote districts, as population increases. The absence of land animals accounts at once for the luxuriance of our primæval forests, and the scarcity of phosphoric acid on the surface of the soil. Had the herbivora been well represented in the past, they would have destroyed the young trees, and at the same time have concentrated the plant food. The existence of dense forests proves that Victoria contains no barren land, for soil that will produce such trees will most assuredly produce a bounteous harvest when its forces are controlled by the intelligence of man.

CHAPTER III.

CLOSER SETTLEMENT STUDIES.

THE GENERAL PURPOSE FARM.

In all cases where comparatively small areas of land are worked, it is of the utmost importance that the value of farmyard manure be properly understood. On many parts of the Continent of Europe, the prosperity of the farmer is measured, not by the size of his bank balance, but by the size of his heap of manure; and there is no question that in nearly all parts of Victoria the chief lesson the average settler has to assimilate is the all important character of farmyard manure. As instances of the revolution which a good supply of manure produces on poor soils, the whole of the market gardening land in the Caulfield and Brighton districts may be mentioned. This country, in its natural condition, is poor, undulating, sandy soil. Originally it was covered fairly thickly with heath, messmate, and tea-tree scrub, and here and there, in subsequent years, a dense growth of bracken. For grazing purposes, the land, even when it is cleared, is comparatively useless, yet the market gardeners have transformed this district into one of the most flourishing and prosperous farming communities in Victoria. It may be said that they have succeeded simply because they have been able to transfer the fertility from the Melbourne stables at comparatively small cost. This, no doubt, is the case, but there is no reason why every farmer should not produce practically as much farmyard manure as his land requires. The chief point which must be kept in sight is the fact that a very large part of the produce of the farm must be fed directly or indirectly to live stock. The live stock are kept for the double purpose of producing a good return for the food which they consume, while at the same time they produce the manure which is necessary to unlock the fertility of the land. It may be considered a kind of paradox to state that the manure from the farm animals will enable fodder to be grown in quantities more than sufficient to keep the animals themselves.

150-ACRE FARMSTEAD, BOISDALE.

This, however, is really the case, and the explanation is that the manure transfers to the ground not only considerable quantities of plant food, but, what is vastly more important, it also transfers to the land the means by which the natural fertility of the soil can be unlocked. The plant food of the soil is unavailable so long as it remains in the insoluble condition. Even the poorest soils contain very large quantities of plant food in this condition, and investigations of recent years have shown that it is through the continual action of many kinds of micro-organisms that the plant food is changed from the insoluble to the soluble form. Why farmyard manure is so important for this purpose is simply owing to the fact that the warmth and moisture of the intestinal tract of all the higher animals constitutes a huge incubating place, where the useful bacteria or micro-organisms are growing and multiplying with great rapidity. Similar organisms are naturally found in the surface layer of the soil, but they flourish and multiply very slowly, so that the great function of the farmyard manure is the transference of enormous numbers of active micro-organisms from the interior of the animal to the surface of the soil. Once the farmer is fully seized of the importance of these facts, he has learnt the first and most far-reaching generalization in the whole sphere of agriculture. It will be seen, then, that in order to succeed on 60 or 80 acres of land, it is necessary to keep a large part of the land under cultivation, and to feed nearly the whole of the produce to live stock of one kind or another. At first dependence must be placed on artificial manures, but as the number of live stock increases these are less important. In all cases, however, it will probably pay to spend five shillings per acre in super.

Rotation System.

The long established success which has attended ordinary methods of rotation of crops, combined with the results of artificial fertilizing of poor land, has made it possible to work a farm on these principles without any assistance from outside sources as far as the manure is concerned. In many parts of Victoria, where land is high-priced, it is usual to find several varieties of grain, roots, and pod-bearing plants in cultivation every year. A little re-arrangement of the work will bring these farms into a uniform system of rotation. A slight modification of existing methods, as seen on the Moe, Koo-wee-rup, and Carrum swamps, will attain the same objects. The poorer the land the more important it is that some such rotation be practised. In most of the midland and southern districts there should be, approximately, four years' cultivation and two years' pasture secured off each paddock. Assuming that the land is fairly uniform in fertility and drainage conditions, the farm should be divided into six equal paddocks as will be seen in the sequel. The necessary fencing off may be spread over a number of years, for it is only as each paddock goes out of cultivation and is devoted to grazing that fencing becomes necessary. When the full course of rotation is attained, the paddocks will be used in any given year as follows:—

A. Pasture.
B. Oats.
C. Winter fodder and maize.
D. Roots and leguminous crops.
E. Do. or barley.
F. Pasture.

The Oat Crop.

When a settler is beginning work on a new piece of land of average quality, the best plan is to make this the first year's crop. Oats are able to establish themselves on rougher and more cloddy ground than most crops. They respond well to artificial manures, and the produce, either in the form of hay or grain, is always of the utmost service to the farmer for home consumption. Of course, the preparation and cultivation of the land should be as thorough as possible; and it is much better the first year to thoroughly prepare one or two of the paddocks rather than to attempt three or four. For average conditions in the Southern part of Victoria, a dressing of 1 cwt. of superphosphate, averaging about 20 per cent. of soluble phosphoric acid, and ½ cwt. of sulphate of ammonia, forms the best dressing. If a drill be available, the seed and super. should be drilled in at the same time, and the ammonia broadcasted early in Spring, but for the settler beginning work on a new selection, both the oats and the super. may be broadcasted, and the ammonia applied later in the same way. If the surface is cloddy, the crop will be greatly benefited by a harrowing when the plants are about 6 inches high. On clay soils, drainage is important, both to secure early growth and good mechanical condition of the soil. As tile drains are not to be thought of until the farmer has made considerable headway in the development of his holding, the most practicable plan is to make the water furrows deep, and carefully located, so as to carry off the winter's rain as speedily as possible. It must be remembered that a water-logged paddock is unsatisfactory for two reasons. The water itself is detrimental to the crop, and, as the drying must take place by means of evaporation, it follows that the ground cannot become sufficiently warm in

OAT CROP, BLOOMFIELD.

No manure.
33 Bushels.

2 cwt. Sulphate Ammonia.
⅔ ,, Con. super.
⅔ ,, Potash Chloride.
45 Bushels.

spring until the season is far advanced. Drainage is, therefore, all important for an early start and satisfactory growth during the months of September and October. If it is possible to take in hand more than one of the sixths into which the farm is divided, the safest plan, on average conditions is to make oats the first crop in each case, and to introduce the other crops in succession year by year until the full system of rotation is established.

The Second Season's Work.

As soon as the oat or hay crop is removed from our first paddock, the earliest opportunity should be taken to turn in the stubble, so as to have the soil ready for a crop sown with the first rains at the end of the summer. This crop is destined to furnish green winter feed, and to mature sufficiently early to be cleared off by the end of September. On this account, barley and rye are the two best grains, while, in order to secure a greater amount of feeding value, and at the same time to maintain the fertility of the land, a leguminous crop should be sown broadcast with the grain. For this purpose, we have the choice of peas, tares, and the tick bean. In some districts, three or four of the five plants mentioned may be sown together. In most cases, the old fashioned mixture of barley and peas will probably be selected. On poor land, a dressing of 1 cwt. of super. to the acre will pay, while, if the land is sour, lime, from two to five bags to the acre, will have a very marked effect. The green fodder is cut day by day for the cows as soon as the natural grasses give out, and, as each strip of the paddock is cleared, all the available farmyard manure should be spread and the land deeply ploughed. The paddock is thus gradually turned over and left rough during the winter. If sufficient power is available, subsoil ploughing is advisable—a second plough without a mould board following the first

CUT IN THE MANURED SECTION OF MAIZE.

one along the same furrow. Any surplus part of the crop remaining at the end of September should either be eaten off as quickly as possible, or made into silage, so that no delay takes place in preparing for the summer fodder crop, which will be grown on the same land.

In the southern parts of Victoria, maize is, on the whole, the most satisfactory crop to grow, but in dry districts, amber-cane may be substituted for it, or on sandy land, Japanese millet. In the north, amber-cane or imphee is the general favorite, especially in the drier districts. The successful growth of a summer crop without irrigation is dependent on three factors—

1. The land must be fairly fertile..
2. It must be deeply worked, so as to contain a good reserve of moisture from the winter's rain.
3. Every effort must be used to conserve the moisture in the soil for the use of the crop, instead of allowing it to be dissipated by evaporation.

On the average, the crop should be planted during the last fortnight in October, or the first week in November. The ground having been thoroughly ploughed is well worked to bring it to as fine tilth as possible, and I think it advisable to sow all summer crops, including the millets, in drills rather than broadcast. On the average, 3 feet apart is the proper distance between the rows. The importance of a thorough dressing of farmyard manure for the summer crop cannot be over estimated. It not only supplies the nourishment required by the growing plant, but the peculiarity of farmyard manure lies in the fact that it conserves the moisture in the soil. As soon as the crop is fairly up, and the surface of the soil hard enough to carry a horse, a small cultivator should be run between the rows, and thereafter, during the whole period of the growth of the crop, this cultivation needs to be repeated after each shower of rain. It is by preserving the surface 3 inches in a loose and friable condition that the evaporation of the moisture from the deeper portions of the soil is almost completely prevented. As the crop reaches maturity, it may be disposed of either as green feed, or made into ensilage, or allowed to ripen for grain. Where maize is grown, it is much more profitable to utilize the crop through the medium of the silo and for grain, than to feed it as green fodder.

The Third and Fourth Years.

Following on the summer fodder crop, the same paddock should be devoted to one or more varieties of crops, the selection of which will vary according to the particular purpose of the farmer. They comprise potatoes, onions, cabbages, mangolds, and other roots, peas, beans, barley, and wheat. Where onions or potatoes form the speciality, as on most of the reclaimed swamps, both years will probably be devoted to these crops, but, if possible, one year of the leguminous crops should certainly be introduced. Not only do they keep up the fertility of the land instead of exhausting the soil, but a crop of either Yorkshire Hero peas or Canadian Wonder beans is, under average conditions, as profitable as any use to which the land be put. In all cases, our effort is to secure a deeply worked soil, in good condition, and brought to a high pitch of fertility for these crops, and, as in the case of the summer fodder crops, the importance of thoroughly working the soil during the period of growth cannot be over estimated. If dairying and pig-keeping form the backbone of the farm, the fourth year may be devoted either to a leguminous crop or to barley, both for grain, as the grain will come in equally handy for feeding to the pigs. It will be seen that this scheme provides for 20 acres of onions or potatoes on a farm of 60 acres.

The Fifth and Sixth Years. Pasture.

As the first two-thirds of our holding of 60 acres have been gradually coming under cultivation, the amount of grazing left for the live stock is becoming seriously restricted. Under these circumstances, it is necessary to abandon the old idea of grazing from the natural grasses, and to make the pasture a definite part of the fifth and sixth years' rotation. Land which has been cultivated and kept clean for the crops four years in succession is in good condition to lay down to pasture. In some classes of soils, all that will be necessary is to work it with the disc harrow, and to bring the surface to a fine tilth in time to sow with the first autumn rains. On the average, a mixture of clovers with rye grass and cocksfoot will succeed best, but the precise mixture found most profitable varies considerably in different districts. Local information on this point is of much more definite value than a general statement with regard to any particular class of soil. One thing, however, is certain:—whatever mixture is sown, the clovers should preponderate. Of these, the white clover and cow-grass should form the principal part, while on poor land, alsyke, trefoil, and Bokhara clover should also be introduced. European and American experience has shown conclusively the very important part that the clovers play in preparing the way for other varieties of grasses. This is partly explained by their deep-rooted method of growth, and partly by the power they have of extracting nitrogen from the air and leaving it in the form of nitrates, along with the stubble in the soil. These nitrates speedily become available for the subsequent crop. A further great advantage of the plentiful admixture of the clover family is the fact that the fodder they produce contains a much higher percentage of the flesh-forming food than is produced by any other kind of plant. Most of the trouble encountered by Victorians in grazing stock is due, not so much to the actual scarcity of material for the animal to eat, as to the innutritious character of the dried grass, after the seeds have blown out early in the summer. Such "grass straw" is exceedingly deficient in the flesh-forming parts of the food, and hence it is towards the end of summer cattle and sheep rarely are able to maintain first-class condition. The general introduction of clovers will, therefore, have a two-fold benefit and immediate advantage in keeping up the condition of the live stock, and the indirect advantage already mentioned secured by the subsequent improvement of the grasses which are growing along with them. We propose to devote the paddock to grazing purposes for two years. Since there are two such paddocks, it is easy to graze them alternately, and possibly to take a crop of meadow hay off one of them each summer. In addition, there will be the stubbles to graze over. Where more land is available than the amount we have already specified, there is no reason why such a paddock should not be grazed for several years until the pasture begins distinctly to fail. It is then broken up, and the rotation begins again with the oat crop, or with potatoes.

The Management of the Manure.

It will be seen that the plan here sketched out may be called a modified system of intense culture. We aim at keeping a large number of animals on the farm, and of providing them with food by means of cultivation. Two advantages are thereby secured—the animal turns the fodder grown into a much more valuable product, in the majority of cases, than the food it consumes would be if sold in the form of grain or hay; while, in the second place, as has already been explained, the animal provides the manure, which unlocks the latent fertility of the soil. Every effort, therefore, should be made to carry horses, cows, pigs, and sheep on the farm. Both the liquid and solid portions of the manure must be saved, and, therefore, bedding becomes an important part of the scheme. The waste material around an old haystack, wheat straw, purchased if necessary, for the purpose, and above all, bracken fern, which is most valuable from the fertilizing elements it contains, should all be fully utilized. If the bracken does not grow in the immediate neighbourhood, it will pay well during slack seasons of the year to spend a day in carting a waggon load several miles and stacking it for future use. As a general rule, the manure should be at once carted from the stable or cow-house on to the field, spread out there in long narrow strips, which should be ploughed up, say, every successive fortnight. The advantages of this method will be grasped when the changes that occur in the soil are explained. Suffice it to say that under ordinary methods the manure heap is a wasteful method, as far as the fertility is concerned. It is true that well-rotted manure produces a more rapid effect than when applied in the fresh state, but during the process of rotting probably half the value of the material is either washed away by the rain or evaporated into the atmosphere. On the other hand, when covered with a few inches of earth, rotting proceeds perhaps more slowly, but the important advantage secured is—that as the fertilizing elements become available for the plant, they are held securely by the soil, so that very little waste is suffered, either by the rain or by evaporation. Fuller details of the methods of managing the cow and the pig are given in Chapter XV. The necessary buildings need add but little to the capital invested in the farm, while the advantages of having the animals protected from the weather are clearly manifest every winter.

Advantages of Rotation.

Our farm of 60 acres worked on this method will provide much more diversified interests for the family than is usually the case under ordinary methods of cultivation. By moving the crops on to fresh ground from year to year, three advantages soon become manifest. (1) The fertility of the land is kept up. (2) The special crops, such as onions and potatoes, are not grown on the same soil year after year, and, therefore, the land does not become "sick." (3) Sufficient land is provided for any farmer to follow out his own speciality, while the chance of a severe set-back by partial or complete failure of the crop, or by collapse of the market, is completely obviated. Should the price for roots or grain fall below a profitable standard, every particle of all the crops raised on the farm can be fed to the different classes of live stock, and the cheques received from the butter factory, together with the pigs and lambs, will, under average circumstances, give a better return when a number of years are taken in succession than the occasional sensational returns received for onions or potatoes. In other words, it reduces the farm to a systematic industry, instead of being, as is so often the case, half a gamble.

A small farm worked on this method increases steadily in value from year to year. The land, instead of getting hidebound and sour, is kept moving, while the addition of a heavy dressing of manure every two or three years steadily improves its fertility. When it is realized that the roots of nearly all kinds of plants will penetrate 3 or 4 feet into the soil, provided they get the chance, the possibilities entailed by this method soon become apparent. In most cases, our Victorian subsoils, except on the volcanic country, are all that can be desired. Wherever clay is found within a foot or two of the surface, we have a great magazine of fertility to be exploited, and the best of all soils for holding the winter rain for summer's use. The transformation which is rapidly taking place in the poor soils around Ringwood and other adjacent districts is an exemplification of the facts here mentioned. The problem of the farmer, therefore, is to deal with the surface 6 or 8 inches of the land, and to improve the subsoil where necessary by drainage. Hence the importance of deep rooted leguminous plants, and the value of farmyard manure. We not only require to increase the fertility of the surface soil, but, at the same time, its

JAPANESE MILLET.

mechanical condition must be improved, so that the little seedlings find in it a comfortable home. If the objection is raised that this scheme involves much more capital for buildings and fencing, and also more manual labour, the answer simply is that it will pay. The necessary fencing is spread over at least four years, and the returns which are obtained from the well cultivated farm by up-to-date methods and worked on any rational system of rotation are certainly far greater than can be obtained from the same land when devoted entirely to one specialized crop, or when the live stock is allowed during the greater part of the year to be dependent entirely upon what nature provided through the means of the natural herbage.

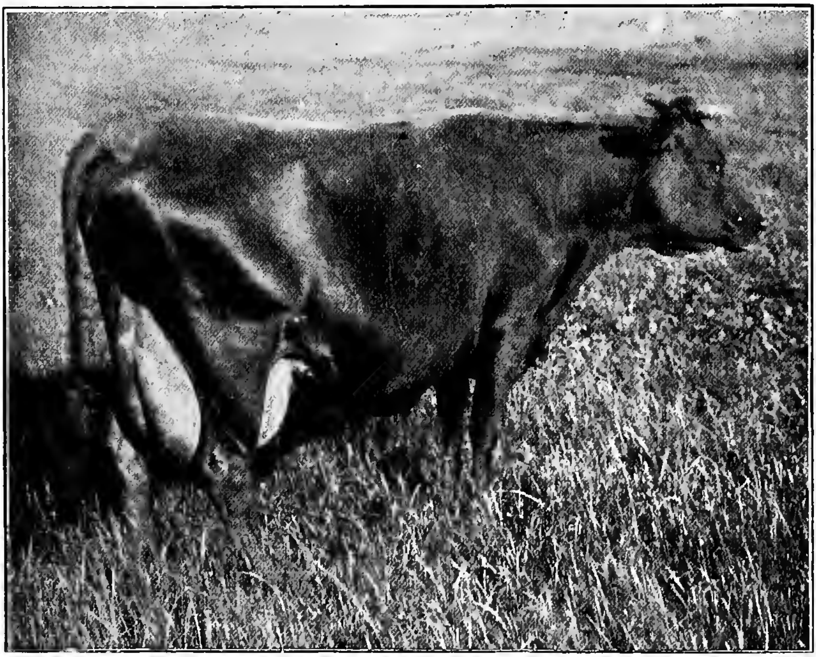
THREE SMALL DAIRY FARMS.

A.—This farm consists of 46 acres, near Yarragon, Gippsland. The whole of the land is now cleared. The last nine acres are just being brought under the plough for summer fodder crops for the dairy herd. These crops are to consist of maize (flat red), mangels, and sugar beet. The land was purchased about eight years ago, being then in its natural state; the price paid was something like £10 per acre.

To the inexperienced it would appear that the amount of labour entailed in reducing it from a wilderness to its present state of high productivity was sufficient to purchase the land without any capital whatever. This is not the case, however, and the owner is thoroughly satisfied with the result of his labour. Few men of his years can lay claim to having performed the pioneering work he has done, and be able to take things comparatively easy on the fruits of his own efforts. We believe this result is due, in the first place, to the indomitable pluck and energy of the man, assisted by the fact that only a small area of land was worked upon. Many men with five times the area of similar land failed during their own lifetime, and even their families after them have not arrived at the stage of advancement as is seen in the case in the farm under review. Much better would it have been had the original selectors been allowed in denselytimbered country like this to take up smaller holdings, say, 50 acres for each adult male in the family. The same efforts concentrated on a smaller area would produce quicker returns, and owing to the prolific nature of the soil the produce taken off the cleared portion would not only supply the necessaries of life, but also help to pay for the portion of the clearing of the remainder, and thus relieve the selector of the necessity of the heavy toil of subduing and reclaiming the whole of the land himself. He could employ his time more profitably in the cultivation of the land already cleared, and in tending his stock. This feature stands out prominently in the case of the farm under review.

The farm is divided into thirteen paddocks, varying in size from two to eight acres, and when asked the reason for such close subdivision, we were informed that as a certain area, no matter how small, was cleared and made ready for the plough, it was placed under cultivation, so that it might be producing revenue, whilst the remainder was being prepared. In this way prompt returns were secured, and in the owner's own words "the wolf was kept from the door." Due care was taken in the clearing of small areas that no unnecessary fencing was erected, and those erected could be allowed to stand permanently.

In addition to clearing, the land is all underground drained. Trenches about 2ft. 6in. deep are made every 2 chains, running north and south the full length of the farm. These are filled with split rails and covered with tussocks, and the soil spread over the top. Little evidence of this work can be seen on the surface, as the grass is growing as thickly as on any other part of the paddock. The result of this work, however, is apparent in the healthy hue and the magnificent growth of the grass. It is intended to intersect these drains with others running east and west, so as to more thoroughly drain the land.



THE SETTLER'S FRIEND.

The principal pastures grown are alsyke, cow grass, and rye grass, a luxuriant growth of which is seen in all of the paddocks. Up to the present the whole of this farm has been devoted to dairying, with the exception of about 2 acres that were sown in potatoes and onions last year, and a similar area will be devoted to the same purpose this year. Maize and root crops (mangels and sugar beet) are the fodder crops grown, the former is fed in the summer and autumn green, and the surplus conserved in the form of ensilage. The method of making silage is cheap, and evidently gives good results, the maize being cut and carted into a stack, packed between upright posts and well weighted, little or no waste takes place, and the stock relish the food and yield well on it.

There are fourteen cows in milk now, and seven more to calve. The yield of milk at present is the lowest for some considerable time, chiefly on account of the continuous cold weather, and the fact that the severe winter kept the grass late in coming, and the supply of home-grown fodder in consequence ran short.

The yield for the season 1904-5, from June to end of May, is as follows. Payments are made every four weeks, hence the inclusion of thirteen payments in the year:—

No. of Cows in Milk.		Gallons Milk.	Test.	Price per lb.	Cheque.		
					£	s.	d.
June, 1904 ...	13	622	4.8	9d.	12	12	6
July ,, ...	13	568	4.7	8d.	10	1	4
August ,, ...	13	524	4.8	8d.	9	9	2
Sept. ,, ...	10	482	4.3	7¾d.	7	9	6
October ,, ...	10	471	4.1	7¼d.	6	19	10
November ,, ...	12	611	3.8	8d.	8	11	6
December ,, ...	14	1,002	3.9	8d.	14	8	10
January, 1905 ...	14	1,072	4.	7¾d.	15	7	3
February ,, ...	16	1,159	4.	7¾d.	16	12	3
March ,, ...	16	1,217	4.1	8d.	18	10	0
April ,, ...	16	1,032	4.4	8¾d.	18	10	8
May ,, ...	16	729	4.6	10¼d.	16	1	11
May ,, ...	16	679	4.6	10d.	14	12	6
		10,168			169	5	7

The actual average yield of each cow taken from the number of cows in milk each month is 726 gallons, the value of which was £12 1s. 10d. per cow per year. The average number of cows in actual milk was fourteen. Amongst the herd were five heifers with their first calf, and three of the cows aborted, but were kept in milk. Some of the best of the cows are now very old, but still continue to yield profitably; the whole are of mixed breeding. A Shorthorn bull from a good dairy cow is used for breeding purposes. In addition to the twenty-one cows milking and to calve, there are ten head of other stock, including three horses and one bull.

Last year fifteen poddies were sold, realizing £1 8s. each, and two fat cows were disposed of at £5 each. A two-year-old draft filly, the progeny of one of the farm mares, is now valued at £30.

£30 is the actual amount estimated as profit from pigs.

The product from half-acre under onions was £30, and three-quarter acre potatoes £12. Yorkshire hero peas (5 bags) were grown and sold, realizing £8 15s. net.

Onions and potatoes were used for household purposes, and two tons of potatoes are kept for seed, the value of which is not taken into account.

The total result from sales as enumerated above is £111 15s., added to milk cheques £281 0s. 9d. from a 46-acre farm in one year. The enhanced value of the two-year-old draft filly could for the year safely be calculated at £10. The two tons of seed potatoes would give another £14, bringing the total up to £305 0s. 7d., or the respectable average of £6 12s. 7d. per acre per annum.

The owner contemplates erecting an up-to-date milking shed as his next move, and after that a modern silo, and he himself says he intends making the farm do a little more in future, and enable him to do a little less himself.

It may be mentioned that the cows are given about three or four weeks' rest before calving, are rugged in winter, and fed on ensilage, chaff, and bran; when the former runs out, mangels and sugar beet are used.

B.—This is another farm in the same district, on the fringe of the Moe swamp. The land was purchased about five years ago. The original holding was 58 acres. This was cleared of timber and scrub, and put under pasture and crop. Sixty-two acres have lately been added to the holding, only a small portion of which is yet available for depasturing and cropping. The total area consists of 120 acres, of which about 80 have been cleared and improved. The amount of stock carried at present is over 70 head.

The number of dairy cows is 30, but never more than 27 are in milk at any one time. The cows are of mixed breeds, showing a lot of Jersey and Ayrshire blood, the latter predominating, and are of small size, being what you would call "good little cows." That this is true of them will be seen by the following results for the year ended 31st May, 1905. There are thirteen payments in the year:—

	Gallons.	Test.	lbs.	Value.		
				£	s.	d.
June, 1904	1,235	4·3	593	22	5	0
July ,,	693	4·3	332	10	9	5
August ,,	540	4·6	287	8	13	8
Sept. ,,	689	4·1	314	10	2	11
October ,,	1,394	4·	604	19	3	9
Nov. ,,	2,209	5·6	878	29	5	6
Dec. ,,	2,977	3·7	1,217	40	11	8
Jan., 1905	2,757	3·8	1,162	37	10	6
Feb. ,,	2,465	4·1	1,124	37	9	6
March ,,	1,699	4·2	795	29	0	1
April ,,	1,264	4·3	607	24	9	5
May ,,	1,311	4·4	645	26	18	3
May ,,	886	4·5	447	16	15	4
				312	15	0

The total value of milk produced and sold is £312 15s., to which must be added £90, value of pigs and calves, or a total from this farm of £402 15s.

The pastures consist of alsyke, white clover, cow grass, and rye grass. Maize is grown for fodder, and conserved in the form of stack ensilage.

At one time last season, the directors of the Trafalgar Butter Factory, wishing to verify the results obtained from the herd, and knowing how many cows were milked, the manager of the factory was instructed to attend, unknown to the owner, weigh the milk from each cow, and take a sample for testing. The following were the results:—

No.	lbs.	No.	lbs.
1	38	11	48½
2	51½	12	47
3	52	13	37½
4	44	14	51½
5	55	15	52
6	41½	16	50½
7	31½	17	58½
8	40	18	14½
9	38	19	49
10	36	20	45½

Total, 912 lbs., or 91 gallons for the day, from 20 cows, averaging 4½ gallons per cow. The remaining 10 cows were strippers, and gave 20½ gallons. The whole 30 averaged over 3 gallons per cow. The average test was 3.7 per cent. of butter fat. At the present time (October, 1905) there are 27 cows milking, yielding 75 gallons daily, and averaging 3.8 butter-fat test.

C.—While at Nagambie in connexion with the farmers' classes being held there, we were told of a herd of pure shorthorns which gave very good results. On inspection, we found that they were the remains of a herd which had been kept pure for between 20 and 30 years. Pure shorthorn bulls have always been used. The herd in milk last year consisted of 11 cows, mostly heifers with the first calf, but these did not calve until they were 2½ to 3 years. They were consequently well grown, and bear out the contention that heifers should be this age before coming in, when they will give returns almost equal to mature cows. In the long run, they will be far more profitable than if brought in earlier, when their growth is checked, and, if persisted in, will gradually reduce the average size, and, consequently, the production per head of the herd. Although these cows are pure shorthorn, many are typical dairy cows to all appearance. When there are steers for sale, they realize, when about 1½-2 years old, £1 to 30s. per head at auction more than those from other herds; and this, taken in connexion with the returns for butter, goes to show that the dual purpose cow is not altogether the myth many people suppose.

Eleven cows were milked last year, and gave a total return of £123 1s. 8d. for butter ex cream supplied to Messrs. Boddy and Partridge's Seymour factory, or an average per cow of £11 3s. 9d. In addition, butter and milk for the family were kept out, and the skim milk used for calves and pigs. We saw the morning's milk from one typical dairy cow weighed. It turned the scale at 33 lbs. net. We afterwards tested this with three others, which contained 4.3, 4.0, 3.9, and 3.8 respectively; 33 lbs. at 4.3 per cent. equals over 1½ lbs. of butter, and this for the morning's milk must be considered good, as we saw that the cows were milked late the previous evening, and our visit was quite a surprise. The cows are mostly fed on a 40-acre paddock of lucerne. These cows had never been tested before, and so no system had been followed in culling, and not much interest taken in dairying now, although it had been extensively conducted and had been a source of great profit. We were able to awaken renewed interest, and feel sure that a Babcock tester will be introduced and operations considerably extended.

The following are the monthly cheques from the factory:—

Date.		£	s.	d.
Sept., 1904	...	10	17	10¾
Oct., 1904	...	11	6	3½
Nov., 1904	...	10	19	0¾
Dec., 1904	...	18	7	4
Jan., 1905	...	13	1	3
Feb., 1905	...	9	5	8
Mar., 1905	...	7	6	3½
April, 1905	...	8	4	8
May, 1905	...	8	6	6
June, 1905	...	4	19	4
July, 1905	...	8	2	9
Aug., 1905	...	12	4	8
Total ...	...	123	1	8

THE IRRIGATED DAIRY FARM.

The method by which the small dairy farm may be made the corner stone of a successful system of closer settlement is a matter that calls for careful consideration at the present time. If a man is to obtain a good living from less than 100 acres of land, it is quite certain that a new problem has to be faced by the farmers of Victoria. The old system of working farms of 320 acres and upwards, chiefly by grazing, supplemented by a certain amount of cultivation of wheat or oats, will not apply to much smaller areas in face of the tendency of the market values of most kinds of produce to shrink when periods of ten or fifteen years are made the basis of comparison. Under these circumstances, it may be interesting to see what can be done with very small areas under modern systems of management.

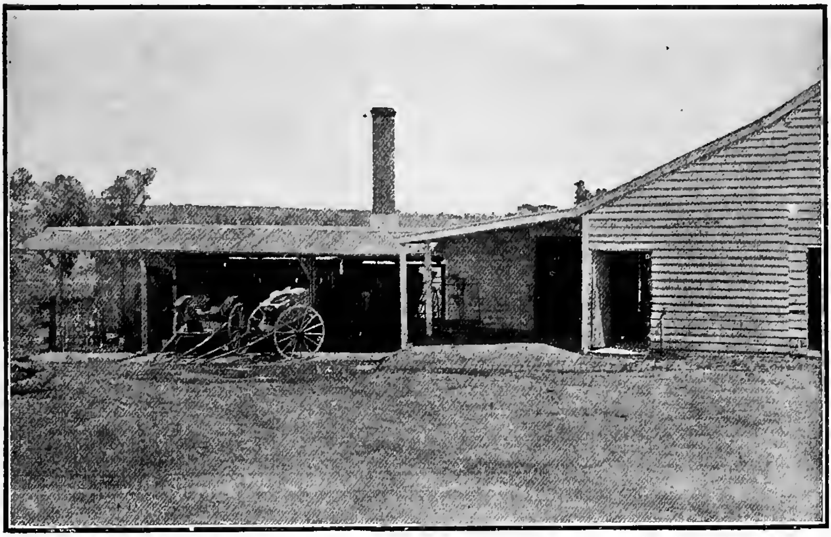
FACTOR I.—THE DAIRY HERD.

Flora Hill Dairy Farm.

This farm, the property of Mr. J. Cumming, is less than 25 acres in extent. It is situated 1 mile south of the Bendigo railway station. On it there are kept 30 head of cattle, producing at the present time 60 gallons of milk a day. Two horses are always on the farm, sometimes three, and there are often a number of calves in addition. These results are so extraordinary that one would expect that there is something novel either about the land or the method of working the farm, but this does not happen to be the case. The land is the ordinary mixture of clay, slate, and quartz to be found on most of our gold-fields. Outside the fence of this farm it seems to be absolutely worthless from the agricultural point of view. The herd is far above the average, but the cows might easily be equalled in any of our dairying districts. The secret of Mr. Cumming's success lies in the application of water and farm-yard manure in a region of nearly continuous sunshine.

The Methods Adopted.

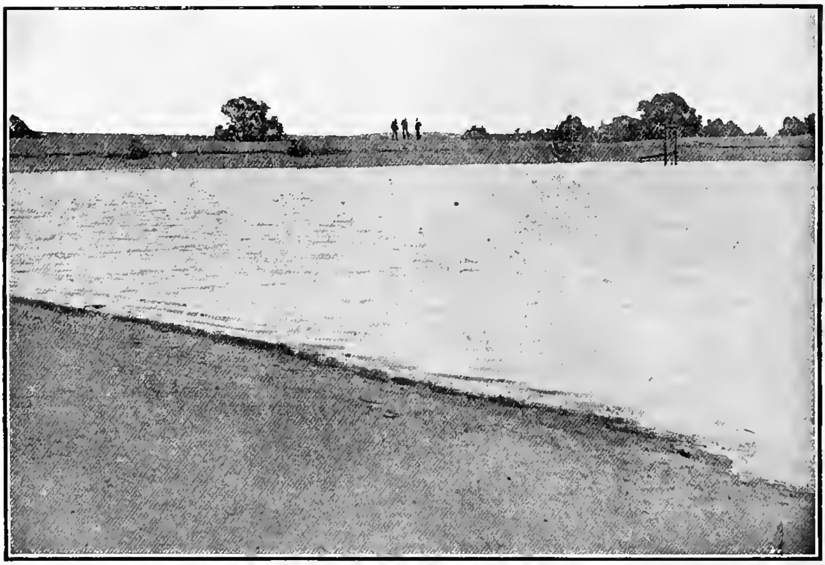
The farm is divided into six paddocks, averaging a little more than 4 acres each. One of these was formerly used as a slaughter-yard, so that in it there is an accumulation of organic matter from bygone years. But this one is not much more productive than the others, and all the paddocks have been brought nearly to the same pitch of fertility, and another season's work will place them all on the same level. The first operation undertaken is to break up the surface from four to six inches deep. This can only be done after heavy rain, or after the ground has been soaked from the reservoir. A good team of horses and heavy plough are required to do the work. When the land has been turned up rough for several weeks, especially in winter, the soil begins to mellow and become more crumbly. It then receives a heavy dressing of farm-yard manure, if possible at the rate of 40 tons to the acre. This is then ploughed under, and a crop taken off the paddock. After a crop of maize has been used for summer fodder the paddock is laid down with a mixture of clovers and rye grass. The clovers are chiefly white and red, the latter predominating. At present four of the paddocks are laid down to the above mixture, the fifth will be broken up in the course of the next three months, and the sixth one is carrying a magnificent crop of maize. This crop, which was sown broadcast, on 15th October, 1904, varies in height from 7 to 10 feet, and by taking the average obtained by weighing 4 square yards of the best part of it, and an equal area of the worst, it was found to be yielding, on 21st January, at the rate of 40 tons to the acre. The little grazing paddocks carry the cattle for about a week in rotation, and each is then irrigated and allowed to rest for three or four weeks.



FACTOR 2.—WHERE THE MANURE IS SECURED.

The Management of the Manure.

From English and American sources we know that an average cow produces at least 45 lbs. of solid and 15 lbs. of liquid excrement in the day. Valued at the present Melbourne quotations for nitrogen, phosphoric acid, and potash, this manure (if all the ingredients can be secured) is worth 10s. per ton. By housing the cows every night in the year, except three months in the summer, about half-a-ton a night is secured from the 30 cows. *It is this 135 tons of manure which make all the difference between success and failure.* The cows are stabled, fed, and milked in the same shed. The bedding used is wheaten straw. With a little extra care both cows and the byre are kept perfectly clean. It will be seen that the fertility is kept up by the oldest method known to mankind—a method, however, which seems to have been strangely forgotton by most Australian farmers. Mr. Cumming also secures a small amount of stable manure from the city.



FACTOR 3.—SPENCER'S DAM.

Irrigation Methods.

Water for irrigation purposes is available from two sources—Spencer's dam (an old mining dam holding about one million gallons) and from the Huntly race, a branch of the Coliban water supply. The water is purchased from the race at the rate of 1d. per 1,000 gallons. For the five and a half months ending 19th January, 2,200,000 gallons have been used from the race, and Spencer's dam has been half emptied. The total amount used is, therefore, less than 3½ million gallons, or the equivalent of 7 inches of rain. There was a good rain in October, at the time the maize was sown, but since that date the weather has been exceptionally dry. Yet this amount of water has been sufficient to keep the pastures in first class order, and to raise the crop of maize already described. Last season, when the rainfall at Bendigo for the six months, October, 1903, to March, 1904, amounted to 10 inches, the consumption of water from the Coliban race was less than one-fourth of the corresponding months this season.

The method of applying the water is the simplest known. The farm is situated on the side of a hill, having an average slope of 1 in 20. Small channels about the size of a plough furrow are dug along the upper side of each paddock, and from these the water is led over the land at successive intervals of 30 or 40 feet. In a few cases similar channels have to be made a little way down the slope of the hill, in order to lead the water past low-lying areas, and on to the more distant parts of the farm. Very little work has been done in order to grade or prepare the land for irrigation.

It is evident that two questions have to be answered at this point—first, why do not certain parts become waterlogged? and, secondly, why is so little water sufficient to do the work? I think the nature of the subsoil largely explains both. The slaty rock everywhere comes close to the surface, and the layers of the rock are standing nearly vertical. It follows, therefore, that as soon as the surface soil is saturated, the bulk of the water, so to speak, slides down hill over the surface of the rock, while a certain amount of it soaks deep into the rock between the layers of the rock. It is then safe from evaporation, but still available for the roots of the crops. The large additions of farmyard manure which have been made to the land all tend to increase the water-holding capacity of the soil. Decayed vegetable matter is the most effective agent known for accomplishing this object.

Results.

Mr. Cumming sells practically the whole of the milk retail in Bendigo. The average quantity is 55 gallons a day. There is not an opening for many farms to be worked precisely on these lines in any one neighbourhood, but there is no reason why one or two such farms should not be met with in proximity to every town of 2,000 inhabitants. On the other hand, the scope for farms of this kind in connexion with the dairying industry is almost unlimited, and each would comfortably support a family. Averaging the milk at 48 gallons a day and the price at 4d. a gallon, the returns from cream alone will amount to £292 a year. The skim milk forms the chief part of the feed for pigs, and it is a very low estimate to reckon the returns from pigs and calves at one-fourth that derived from the butter factory. This would bring the gross returns up to £365 a year. To work a farm in the way described will employ two men at least, and a team of two good horses will be required. The special circumstances of the Flora Hill Farm require special arrangements. Three men are employed on it all the year round, and the retail price received for the milk is to a great extent discounted by a wages sheet amounting to £300 a year.

It is clear, therefore, that a small irrigated farm in a region of perpetual sunshine can be made to produce sufficient from the soil to keep a family in comfort. It appears also that the amount of labour necessary to manage the cows and pigs can be supplied by an average family with, say, an additional hand employed. But on poor land, even with an abundance of water, the chief factor in the success of the scheme is the farmyard manure. Without it sunshine and water would lose much of their power. The question is not whether, when once established, can a dairy herd be maintained, but is it possible to make the land produce sufficient to build up the herd from the start? In other words, will it be safe to trust to chemical fertilizers alone? Admitting that much of the value of the farm manure is in its unique power of improving the tilth and the water-holding power of the soil, I think we may safely assert that the farm can be started by the use of fertilizers alone. Each cow will consume (including waste), in a year the equivalent of about 20 tons of grass or green fodder. This will remove from the soil approximately 80 lbs. of nitrogen, 30 of phosphoric acid, and 60 of potash. To supply the whole of this at present Melbourne quotations will cost £4. Mr. Cumming's dressing of 40 tons of manure furnishes at least 320 lbs. nitrogen, 200 of phosphoric acid, and 160 of potash. It will be seen that he supplies sufficient for four or five crops in one very heavy dressing. Fortunately, however, even in the poorer soils there are such immense quantities of plant food that much smaller dressings of fertilizers will suffice if there is abundance of water to dissolve this food and carry it to the roots of the plants. From experiments made last summer, when the rainfall everywhere was abundant, it is shown that very satisfactory yields can be produced by dressings of 1½ cwt. of superphosphate, 1 cwt. of sulphate of ammonia, and ½ cwt. of potash chloride. Such an application supplies 15 lbs. of nitrogen, 36 of superphosphate, and 28 lbs. of potash. Its cost is about £1 1s. As we have as yet no experimental plots on irrigated land of this character, these figures cannot be too implicitly relied on; but they are probably not far from the mark. In Bendigo city most of the stable manure is eagerly secured by the market gardeners; but a farmer determined to succeed will take every opportunity of obtaining a load of any kind of town refuse. The water requirements per acre will be from 100,000 to 200,000 per acre, depending on the incidence of the rainfall. These amounts represent 4½ to 9 inches per acre, and will cost, at 1d. per 1,000, 8s. 4d. to 16s. 8d. per acre. With artificial fertilizers and water combined we have to provide for an expenditure of from 30s. to 40s. per acre. At Mildura a number of settlers are carrying on dairying successfully on land which pays 30s. per acre for irrigation alone.

THE UNITED RESULT.

Suggested Details of the Scheme.

Suppose 20 acres be taken in hand in March, the first work would be to grub the few saplings on the land, and flood it with water, previously ploughing a few light furrows nearly horizontal along the hill-side to check the water running down too fast. As soon as the soaking will admit of doing it, the land should be deeply scarified or subsoiled, ploughed, and harrowed down to a fine tilth. There may be plenty of stones and fragments of slate lying about the surface, but one advantage of this district is the fact that the surface clay loam does not puddle very easily. The land then requires a dressing of ½ cwt. each of superphosphate and sulphate of ammonia, and a crop of oats and peas sown broadcast together, harrowed in. Such a crop will grow quickly all the winter, and would furnish a considerable amount for grazing off, but I think it would not be advisable to buy any cows just yet. If things turned out well, a small stack of hay would be the result, and should be cut as early as possible. If a comparative failure, it should be ploughed in as green manure. In any case, flood the 20 acres again in October. Plough the land at once, broadcast the remainder of the fertilizers, viz., 1 cwt. super., and ½ cwt. each sulphate of ammonia and potash, and sow with maize, or perhaps 10 acres maize and 10 acres amber cane or Japanese millet, both drilled in, if the implements are available. There are two reasons why I suggest two crops instead of maize alone. First, there is less risk of a complete failure, and secondly, the earlier maturing crop may be consumed first, and half the land laid down to clover and rye grass. If the land is still rough and cloddy, I should recommend that successive sowings of maize be made over the whole area. As soon as the green summer crop is ready to cut for fodder, a few cows may be purchased, and the farm will begin to return something towards the working expenses. With a really good crop of maize, the success of the scheme will be assured. When the first of the grazing paddocks is available for use, the cows may be increased cautiously, and the pig begin to earn his quota. The property could then be worked exactly on the lines adopted by Mr. Cumming, who has himself no doubts as to the success of the plan. An alternative scheme would be to have 10 acres grazing, 5 acres lucerne, and 5 acres under maize for a summer, and peas and barley for the winter crop. When the manure from the cows and pigs becomes available, apply every particle of it to the cultivation paddock. As soon as one of the grazing paddocks shows signs of giving out, break it up to use it for crops for a year or two, and lay down the previous cultivation paddock to grass. Mr. Cumming's present mixture is:—red clover, 2 lbs.; white clover, 1 lb.; alsyke clover, 1 lb.; Italian rye grass, 15 lbs.; prairie grass, 5 lbs. He sows his maize about 2 bushels to the acre broadcast.

CHAPTER IV.

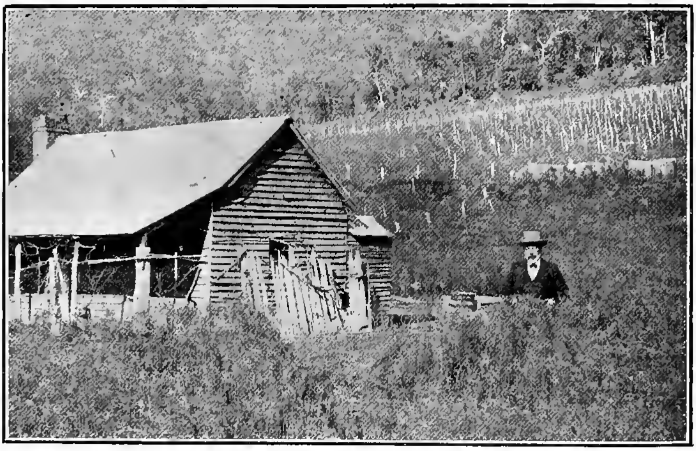
A FARM PEST.

ST. JOHN'S WORT.

(*Hypericum perforatum. Linne.*)

Description.

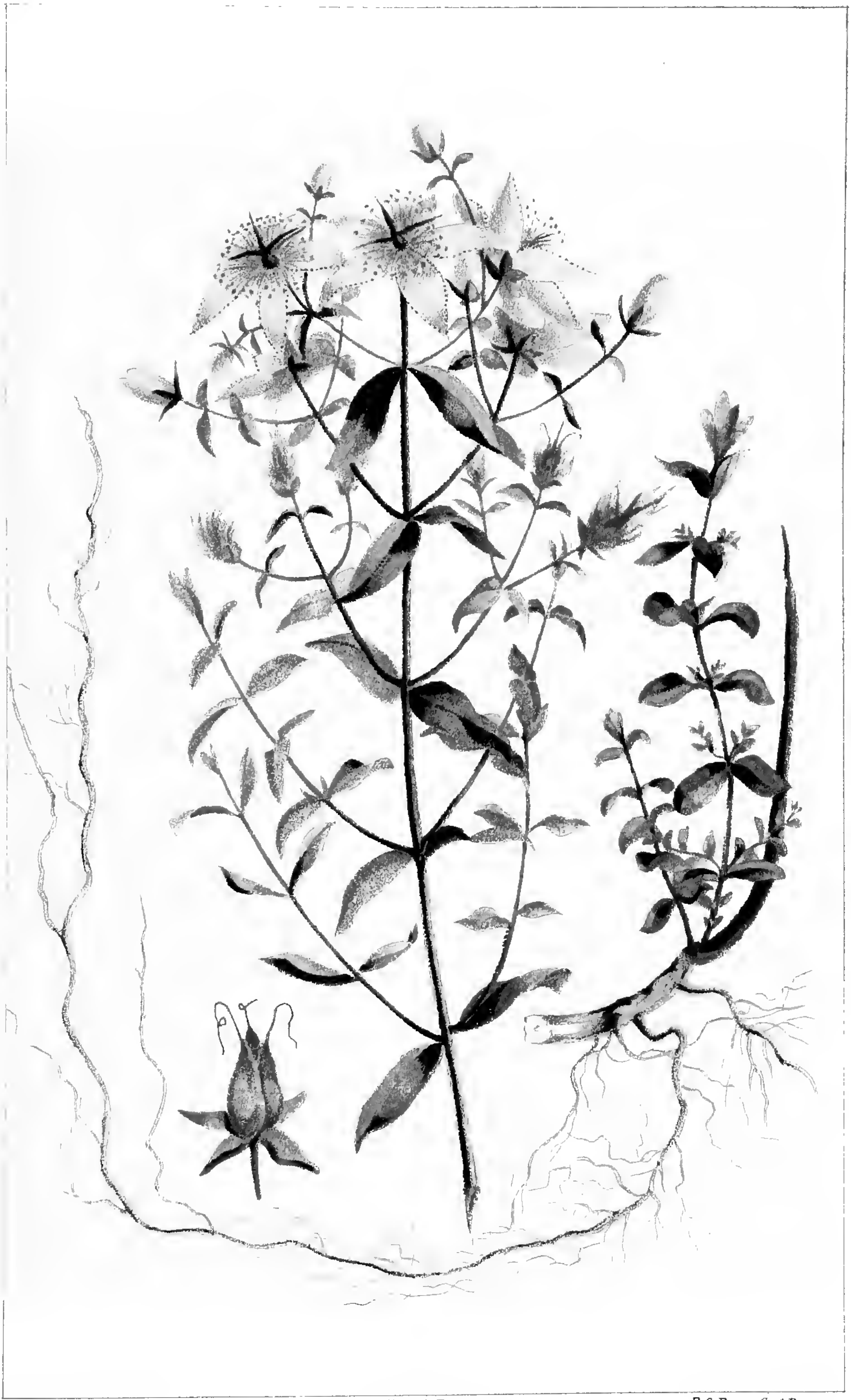
Perennial, erect, and of a peculiar bluish-green colour; height, from 1 to 5 feet; flowers, yellow; wood, reddish in colour; roots branching from a tuft-like base, and descending to a depth of from 2 to 4 feet. This plant is to a certain extent injurious as fodder. It yields a reddish-looking oil, which pharmacists in the old days held in great esteem.



GARDEN AT BRIGHT FROM WHICH ST. JOHN'S WORT FIRST SPREAD.

Distribution in Victoria.

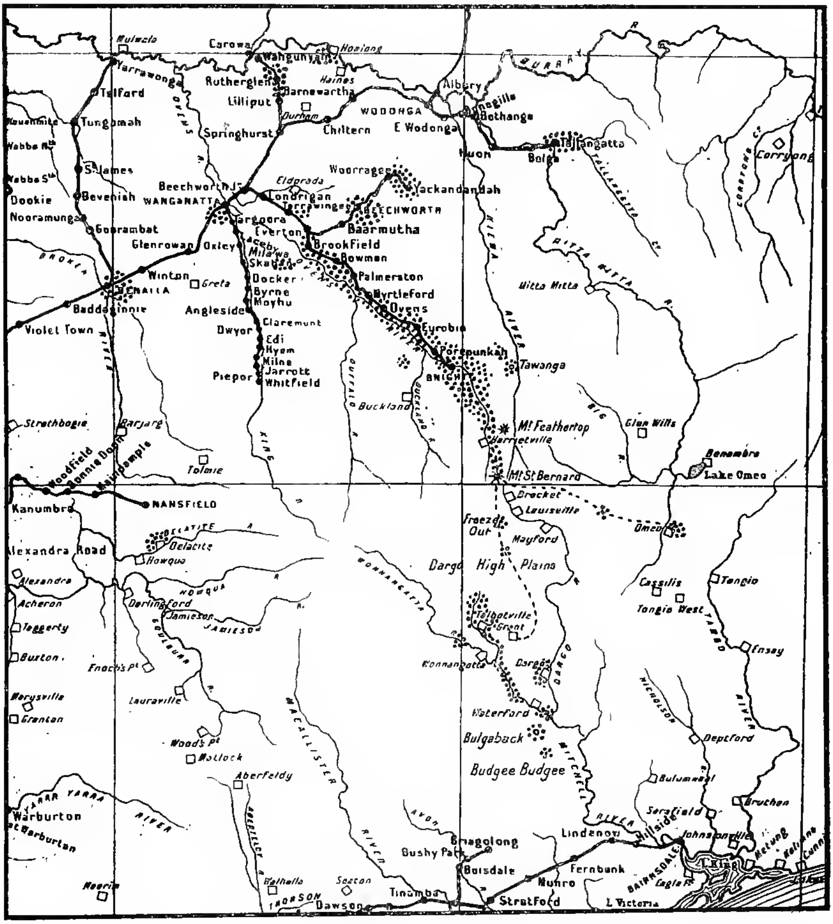
This pernicious weed first made its appearance in Victoria about 25 years ago, and has been gradually, but surely, spreading ever since. According to information gained upon the spot, it would appear that an old lady introduced the seeds from Germany for medicinal purposes, with the result that the plant spread with great rapidity in the little garden. Upon uprooting the plants and throwing these over her fence, stray and travelling stock conveyed the seeds to the Bright race-course (which is nearly opposite the first infested place), where the plant is locally known as the "race-course weed." As time wore on, the plants grew and flowered profusely, with the result that the seed was rapidly distributed, especially along the routes taken by stock.



S.W.L. Cochrane, Delt. C. French Direx R.S. Brain Govt. Printer

"ST JOHN'S WORT."
(*Hypericum perforatum*) Linne.

I have not attempted to give any elaborate botanical description of the plant, as this, to the average settler, would be next to useless, but have relied upon the coloured plates, taken from nature, to enable any one having this weed to recognise the same at a glance. With regard to the rate and scope of its spreading, it may be mentioned that, from personal observations made by Inspector Davey and myself, the areas infested are much greater than was at first supposed. To show in a plain way the extent to which the plant has spread, the following information may prove interesting. The areas given are approximate:—Victorian Alps, say from Upper Harrietville to Budgee-Budgee and Waterford (the latter place being near the head waters of the Mitchell River), and Omeo—about 1,000 acres. Coming lower down, although the country is mostly hilly, some of which hills rise to a height of 2,000 odd feet, the weed, as Bright is approached, becomes much more dense, the first place showing badly being known as Germantown, and it gets thicker as we near Bright, and from thence along the railway line to Myrtleford, and sparsely across to Beechworth, Eldorado, &c. In the Bright district, roughly speaking,



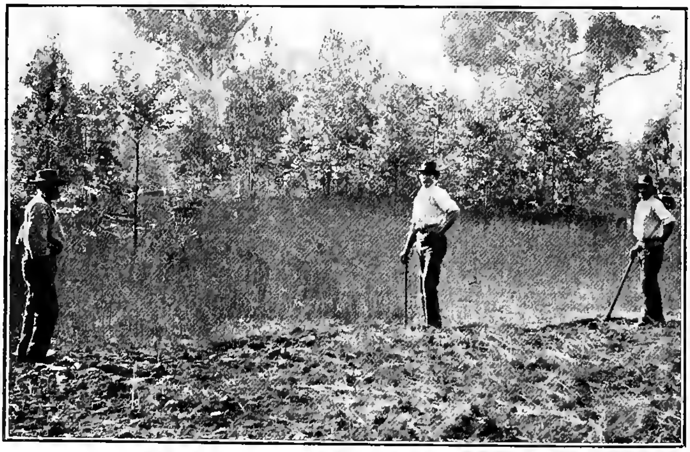
from Germantown to Myrtleford, taking a narrow strip of, say, from 2 to 3 miles in width, we estimate about 6,000 acres to be more or less affected, the worst cases being in or close to the Bright township. In the Beechworth district, which by road is between 30 and 40 miles from Bright, the affected area, as noticed, is about 866 acres; in Rutherglen about 100 acres; in the parish of Carlisle, 1,820 acres; in the parish of Gooramadda, in scattered spots, 400 acres; in Tallangatta, parishes of Noorongong, Yabba, and Tallandoon, about 500 acres; Lilliput, 263 acres; Narong, 161 acres; Delatite, 100 acres; Milawa, small patches; in Benalla shire, parishes of Warrenbayne and Lurg; South Gippsland, in smaller patches, which will soon become larger; and in a few other places.

To make the reading easier, the following table has been prepared, and was embodied in a report, prepared by myself, and presented to the Department in 1902. Since that time, however, other patches have been found, and I am indebted to Mr. Smith, engineer of the Bright shire, and others for the figures here given. The dots on the accompanying map clearly show the extent to which this weed has increased.

Bright District, Crown land 3,000 acres, private land 2,500 acres: Beechworth district, Crown land, very little; private land, 866 acres; Narong district, private land, 161 acres; Carlisle district, private land 1,820 acres; Lilliput district, private land, 263 acres; Gooramadda district, private land, 400 acres; Rutherglen district, private land, 100 acres; Benalla shire, private land, small patches; Victorian Alps, mostly Crown lands, 1,000 acres; South Gippsland, shire lands, small patches; Delatite district, private land, 100 acres. Roughly approximate areas infested—Private land, 6,210 acres; Crown land, 4,000 acres; total, 10,210 acres.

Eradication.

The great difficulties in the way of eradication are, first, the inaccessibility of much of the infested country; and, secondly, the question of cost. In the former case, the weed ascends the hills, many of which would be difficult to ascend, even if one went on all fours; also the absence of water at great elevations, and, in the lower lands, the terrible irregularity of the surface on the old gold workings. In the Alpine


ERADICATING THE WEED AT BRIGHT.

and sub-Alpine regions the country is wild and difficult in the extreme, so that the cost of eradication in such places would, of course, be enormous, and could hardly be computed with any hope of accuracy.

In this short paper the whole of the experiments could not be given, its principal object being to draw public attention to the dangers ahead, and to advise as to what we have found by actual experience to be the cheapest, best, and most effective means of coping with this serious pest. Our experiments around Bright extended over a considerable period, and a piece of land, 3 acres in extent, was withdrawn from selection, fenced, and treated with chemicals, salt, &c.; but, owing to the peculiar contour of the land, and to the abnormally heavy rains, some of the experiments have not been as successful as we could have wished. The following is a condensed description of the experiments above alluded to:—

ARSENITE OF SODA, 1S. 3D. PER GALLON.

Plot 2.—One-fifth acre on race-course, 160 gallons of mixture, equals 32 lb. arsenic, 24 lb. soda—Material, 10s.; labour, 16s. 3d. Cost per one-fifth acre, £1 6s. 3d.; per acre, £6 11s. 3d.

Plots 3 and 4.—Half-acre in three-acre plot—Ten gallons arsenite, 12s. 6d.; mixture, 200 gallons; labour, 15s. 5d.; cost per half-acre, £1 17s. 11d.; per acre, £2 15s. 10d.

Plot 7.—Quarter-acre, in three-acre plot—Material, 10s.; labour, 7s. 8d.; cost per acre, £3 10s. 8d.

Plot 8.—Quarter-acre in three-acre plot—Material, £1 (320 gallons mixture); labour, 9s. 4d.; cost per quarter-acre, £1 9s. 4d.; per acre, £5 17s. 4d.

Plot 6.—Quarter-acre in three-acre plot—Material, 22 gallons arsenite, equals 440 gallons mixture—Cost, £1 7s. 6d.; labour, £1 4s. 6d.; cost per acre, £10 8s.

Plot 2.—One-chain plot, fronting judge's box in race-course—Material, 7s. 6d.; labour, 5s. 1d. Cost per chain, 12s. 7d.; per acre, £6 5s. 10d.

BETHANGA PYRITES, £2 PER TON.

Plot 3.—One-fifth acre on race-course—Pyrites, 1½ cwt., 3s.; labour, 11s. 1½d. Cost per one-fifth acre, 14s. 1½d.; per acre, £3 10s. 7½d.

Plot 5.—Quarter-acre in three-acre plot—Pyrites, 100 lb., 2s.; water, 200 gallons; labour, 7s. Cost per acre, £1 16s.

Plot 1.—One-chain plot fronting judge's box—Pyrites, 2 cwt., 4s.; labour, 6s. 1½d. Cost per acre, £5 1s. 3d. (1 lb. to 1 gallon water.)

GLOBE WEED KILLER, 2S. 6D. PER GALLON.

Plot in saddling paddock, 2s. 6d. per gallon, 1 in 16, in quarter-chain plot. Cost per quarter-chain—Material only, 12s. 6d.; per acre, £25; labour per acre, £1 15s. Cost per acre, labour and material, £26 15s.

INVICTA, 2S. 6D. PER GALLON.

Plot 11.—Quarter-acre in three-acre plot—1 in 20, at 2s. 6d. per gallon—Six gallons invicta, 15s.; 120 gallons mixture; labour, 9s. 6d. Cost per quarter-acre, £1 4s. 6d.; per acre, £4 10s.

Plot 5.—One chain fronting judge's box—1 in 20—Seven gallons, 17s. 6d.; 140 gallons water; labour, 8s. 4d. Cost per chain, £1 5s. 10d.; per acre, £12 18s. 4d.

MURTON'S SHEEP DIP, 15s. PER GALLON.

Plot 4.—One-fifth acre on race-course—Half-gallon dip, 7s. 6d.; mixture, 135 gallons; labour, 11s. 5d. Cost per one-fifth acre, 18s. 11d.; per acre, £4 14s. 7d.

Plot 9.—Quarter-acre in three-acre plot—5½ pints, 10s. 3¾d.; 1 pint to 36 gallons water; labour, 8s. 3½d. Cost, 18s. 7½d.; per acre, £3 14s. 6d.

Plot 6.—One chain fronting judge's box—One quart dip to 40 gallons water, 3 quarts per chain, 11s. 3d.; water, 120 gallons; labour, 7s. 4d. Cost per chain, 18s. 7d.; per acre, £9 5s. 10d.

MURTON'S WEED KILLER, 10s. PER GALLON.

Plot 1.—Fifty links—one-fortieth acre; weed cut; 2 gallons in 200 gallons water; labour, 2s. 7½d.; material, £1. Cost per acre, £45 5s.

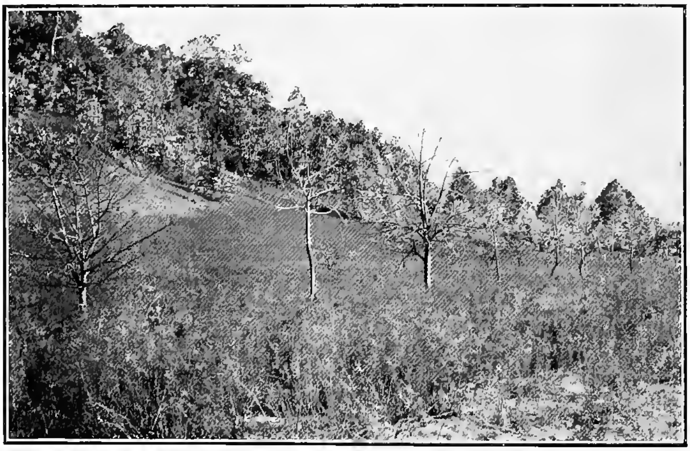
Plot 2.—One-fortieth acre; weed uncut—Two gallons to 200 gallons water; labour, 3s. 6d.; material, £1. Cost per acre, £47.

Plot 3.—Weed uncut; 1 in 200 water; labour, 3s. 0¾d.; labour per acre, £6 2s. 6d.; material per acre, £20. Cost per acre, £26 2s. 6d.

Plot 4.—Weed uncut; 1 gallon in 200 water; labour, 2s. 2¼d. per acre, £4 7s. 6d.; material per acre, £20. Cost per acre, £24 7s. 6d.

Plot 5.—Weed cut—Half-gallon in 150 gallons water; labour, 1s. 3¾d. per plot; labour, £2 12s. 6d.; material per acre, £10. Cost per acre, £12 12s. 6d.

Plot 6.—Weed uncut—Half-gallon to 150 gallons water; labour, 2s. 2¼d. per acre, £4 7s 6d.; material per acre, £10. Cost per acre, £14 7s. 6d.



ORCHARD AT ERIGHT TAKEN POSSESSION OF BY THE WEED.

Plots near Stand.

Plot 1.—One-fortieth acre plots—Two gallons in 200 gallons water; labour per acre, £5 5s.; material per acre, £40. Cost per acre, £45 5s.

Plot 2.—One gallon in 200 gallons water; labour, 2s. 7½d. per acre, £5 5s.; material per acre, £10. Cost per acre, £15 5s.

Plot 3.—One gallon in 150 gallons water; labour, 2s. 2¼d. per acre, £4 7s. 6d.; material per acre, £20. Total cost per acre, £24 7s. 6d.

Plot 4.—Half-gallon to 150 gallons water; labour, 2s. 7½d. per acre, £5 5s.; material per acre, £10. Total cost per acre, £15 5s.

MURCHISON SCRUB EXTERMINATOR, £2 PER 100 LBS.

Plot 5.—One-fifth acre on race-course—100 lbs. to 274 gallons water—Material, £2; labour, 12s. 1½d. Cost per one-fifth acre, £2 12s. 1½d.; per acre, £13 0s. 7½d.

Plot 3.—Fronting judge's box, 1 chain—10 lbs. to 40 gallons water, 96 lbs. in 240 gallons water—Labour, 4s. 4d. Cost per chain, £2 4s. 4d.; per acre, £22 3s. 4d.

SILEX.

Plot 1.—One-fifth acre on race-course—2s. 3d. per gallon—Labour, 8s.; Silex, 17½ gallons, £1 19s. 4½d. (108 mixture); labour and material, per acre, £11 16s. 10½d.

Plots 1 and 2—Half-acre in three-acre plot—Labour, 13s.; Silex, 1 in 6, 24 gallons at 2s. 3d., £2 14s.; 160 gallons. Cost per acre (labour and material), £6 14s.

Plot 10.—Three acres; 1 in 10, with cans; quarter block—Twenty-seven gallons at 2s. 3d., £3 0s. 9d.; 270 gallons mixture, labour, 12s. 11d.; labour and material, per acre, £14 14s. 8d.

Plot 4.—On one-tenth acre fronting judge's box; used 1 in 5—Ten gallons Silex, £1 2s. 6d.—50 gallons water; labour, 4s. 9d. Cost per plot, £1 7s. 3d.; per acre, £13 12s. 6d.

SALT, £1 PER TON.

Plot 12.—Quarter-acre in three-acre plot—Half ton salt, 10s.; labour, 15s. 2d. Cost per ¼ acre, £1 5s. 2d.; per acre, £5 0s. 8d.

Plot 7.—One chain fronting judge's box—Two tons to acre; labour, 3s. 6d.; salt, 4s.; per chain, 7s. 6d.; per acre, £3 15s.

Salt should be used at rate of 3 tons to acre.

SULPHURIC ACID, 1D. PER LB.

Plot 6.—One chain on race-course—Seven gallons acid, 132 lbs. at 1d., 11s.; 7 gallons acid to 63 gallons water; labour, 3s. 0¾d. Cost per chain, 14s. 0¾d.; per acre, £7 0s. 7½d.

Plot 8.—Quarter-chain fronting judge's box—Quarter-chain, 7 gallons acid to 63 water, 132 lbs., 11s.; labour, 2s. 7d. Cost, per chain, 13s. 7d.; per acre, £27 3s. 4d.

As a result of an inspection of these plots on 22nd September, 1905, it was found that plot 1 on race-course, treated with Bethanga pyrites at a cost of £5 1s. 3d. per acre, and finished on 21st November, 1904, was still absolutely free of weed. The next most successful plot was No. 12, in 3-acre plot treated with salt at a cost per acre of £5 0s. 8d., and finished on 29th November, 1904. This plot is on very steep country, and as a consequence the cost of labour was much greater than it would have been in more accessible country. Next comes Silex (plot 4), at a cost of £13 12s. 6d. per acre. Then follow Murton's weed killer and Globe weed killer. The results of these tests prove that arsenical compounds are mostly unfitted for coping with the plant, unless used at a prohibitive cost, and at frequent intervals. Then, by preventing the formation of leaves, they would give the same results as summer cultivation, but would prove very costly; and, from figures already given, it will be seen that as soon as the cost of treatment is reduced, so also is its efficacy. For instance, the Murton weed killer (plots 1 and 2), treated last February, where the mixture was used at 1 in 100, at a cost of £45 5s. and £47 per acre respectively, these plots are still free of weed (22nd September, 1905). Plots 3 and 4, treated with a strength of 1 in 200 last February, show weed freely in patches; these plots cost, per acre, £26 2s. 6d. and £24 7s. 6d. respectively. Plots 5 and 6, treated with a strength of 1 in 300 during February last, are now (22nd September, 1905) covered with weed, showing that as soon as the cost is reduced, its efficacy is reduced likewise. Plots 5 and 6 cost £12 12s. 6d. and £14 7s. 6d. respectively.

DIRECTIONS FOR PREPARING THE MATERIALS.

Arsenite of soda, 4 lbs. white arsenic, 3 lbs. washing soda, 1 gallon water. Boil and stir for half-an-hour, or until dissolved; then use 8 ozs. to every gallon of water.

Bethanga pyrites, 1 lb. to 1 gallon. The best method is to have four or five drums of water boiling at once, and keep dropping in the pyrites and stirring. It is much quicker this way, and less severe on the drums.

Globe Weed Killer, 5 gallons to 80 gallons water (1 to 16). This is a good mixer, and was poured slowly into the water, the latter being well stirred.

HEDGE OF ST. JOHN'S WORT CARELESSLY LEFT BETWEEN TWO CULTIVATION PADDOCKS.

Invicta, 1 in 20. Pour into the water and stir.

Murton's Sheep Dip.—According to the strength required, the dip was merely poured into the water, the latter being well stirred at the time.

Murton's Weed Killer.—This is a good mixer, and was poured slowly into the water and well stirred. It was used at 1 in 100, 1 in 150, 1 in 200, and 1 in 300.

Murchison Scrub Exterminator, 16 lbs. to 40 gallons water.—Mix amount required in small quantity of water, and keep well stirred for a few minutes. This is a bad mixer.

Silex.—Mix half the quantity of water with the Silex, stir well, and then add rest of water and stir again.

Salt.—The weed was first mown. In one test the salt was boiled, in another it was sown broadcast and then watered, and in another was left dry. The latter has given the best results.

Sulphuric Acid, 1 to 9.—Twenty-seven gallons of water were placed in a barrel, and 3 gallons of acid were slowly poured in, the contents of the barrel being stirred at the same time.

CUTTING TO PREVENT SEEDING.

This to be of any use must be commenced before flowering time, and should be done as often as possible, as when cut down this plant, in a very short time, throws up fresh flower stems.

PLOUGHING.

Where possible, this is very successful, but the plant must not be allowed to carry leaves, or the roots will at once take on a new lease of life by being allowed to elaborate the crude sap by means of the leaves. As soon as the plant appears after ploughing, cultivation should be commenced again. Cultivation, unless thorough, is of advantage to this plant; but, as showing that the weed can be beaten, and a good crop taken off badly-infested land, I may point to the fact of the good crop now being taken off the Bright race-course, part of which is now leased for the purposes of cultivation.

HAND GRUBBING.

This has been found by experience to be impracticable, owing to the enormous cost, and to the fact that if any fragment of root be left in the ground, it has the power of forming a bud, and thus making a new start.

Suggestions for Preventing the Weed spreading to "Clean" Districts.

If this and other weeds are to be either stamped out, or kept within reasonable bounds, the administration of the "Noxious Weeds Act" must be at once removed from all local bodies, and left in the hands of the Government. All persons possessing land upon which the weed grows should be compelled to adopt reasonable measures for its suppression, either by ploughing, cutting, burning, or by other treatment. Where a plough can be used, cultivation should be insisted upon, under a penalty for non-compliance. Where land is either steep or irregular, constant cutting and burning should be resorted to, and, where practicable, the methods used by us, and given in this paper, should be adopted. When near streams, the arsenical preparations cannot with safety be adopted, and the same remarks would apply to grazing lands, &c.

In salt we have a fairly cheap and valuable aid in ridding the land of St. John's Wort, and it has the additional merit of being both safe and effective. We find that salt may be had in any quantity for 13s. per ton, and the best results were obtained by using the salt at from 2½ to 3 tons to the acre. On small areas, and on the first appearance of a patch or patches, a piece of corrugated iron, flattened out so as to make it lie close to the ground, or a sheet or two of bark, will kill out the weed in a short time. Pulling up the plants is of little use for the reasons before stated. Unfortunately for us, this weed is of a very hardy nature, and may be found growing upon a stone on which only an inch or so of soil occurs, and is equally at home in gullies of running water, and thrives well when almost covered with snow for three or four months in the year. One thing, however, has been noticed, and that is, that the weed does not grow well, if at all, in places covered with stagnant water, as clay pans, &c., so that flooding, where it can be done, may be of use, and is certainly worthy of a trial.

On land where nothing else could well be used, cutting, for the purpose of preventing seeding, would probably be the best and cheapest method of dealing with it, and even then the weeds would require burning, as the seeds will ripen even after the plants in flower have been cut and allowed to lie on the ground. This plant is easily burned off, this being the most speedy method of preventing the weed from spreading, but the unfortunate part is that both cutting and burning would have to be repeated—no one knows how many times.

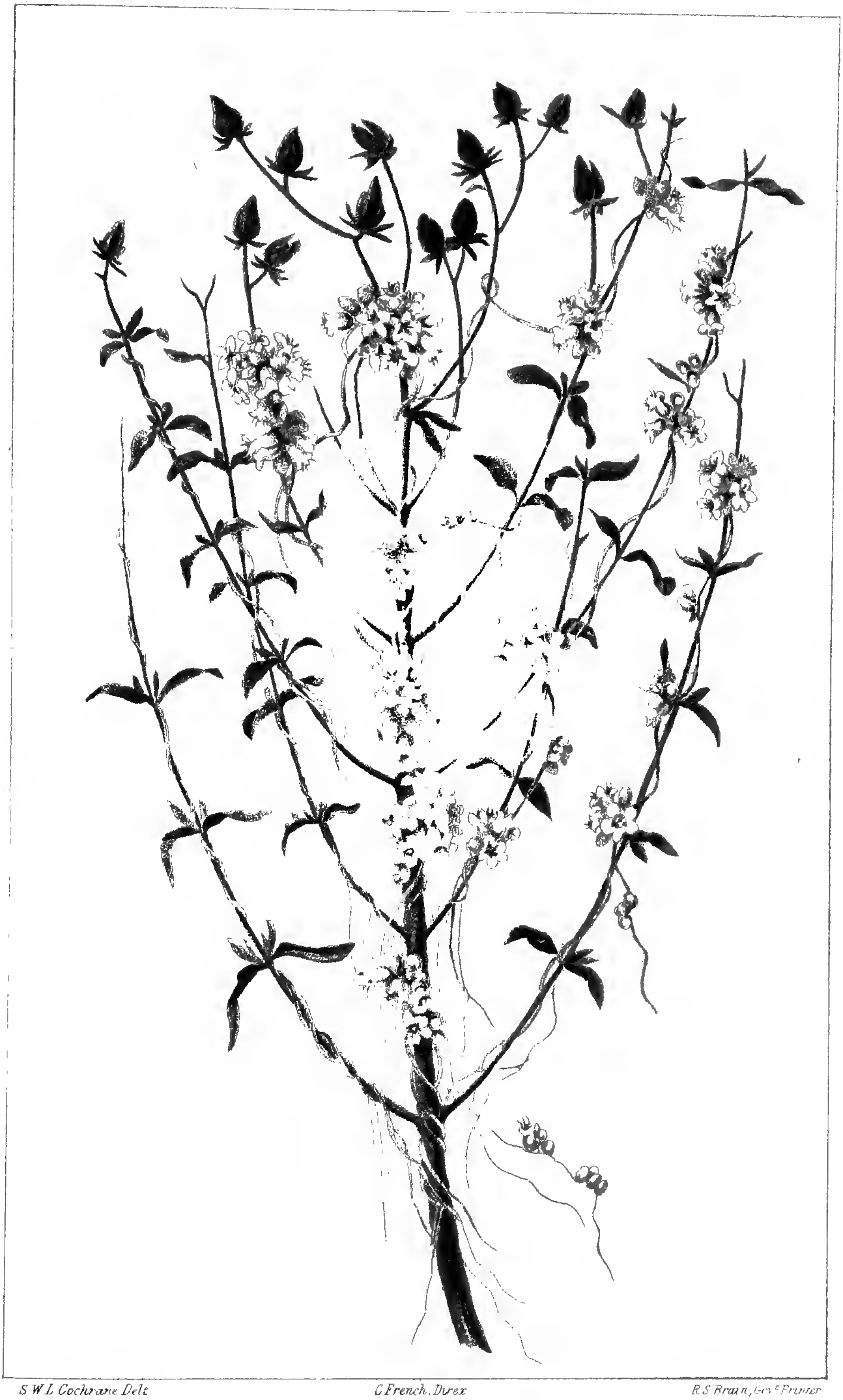
Hay or other cereal crops taken from land on which St. John's Wort is growing should not be permitted to leave the infested districts, as it is by this means that the seed of the weed has been largely distributed.

All shire secretaries, State school teachers, graziers, and others should promptly notify the Department of the presence of the weed should they see it, or hear of it being in their district, as, should the weed get a footing in the rich lands of Gippsland, it will be a bad job for the rural prospects of Victoria.

In dealing with the steep Crown lands before alluded to, we found the Bethanga pyrites to be easily first, and plots treated in November, 1904, at a cost of £5 1s. 3d. per acre, are at the date of writing (October, 1905) still quite free from any appearance of the weed.

Fighting the weed with natural enemies has been suggested, the singular parasite, *Cuscuta Australis*, or Dodder, having attacked the wort with vigour, and has already killed out large patches of it. The Dodder is a bad pest of the farmer, and, if used against the St. John's Wort, would require to be well watched, and kept within reasonable bounds. The coloured plate of the Dodder is here given, so that persons may know it when they see it. The photographs will explain themselves.

The matter of St. John's Wort is a most serious and important one, and, as it is spreading year by year, the gravity of the situation will be apparent to all, and the most determined efforts should be made to cope with the trouble.



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"AUSTRALIAN DODDER."

(Cuscuta australis) R. Brown

CHAPTER V.

IRRIGATION ON THE FARM.

In our moist southern districts, as well as in the drier north, the idea of irrigation generally held is something involving considerable outlay upon storage works, and not less upon the channels and other means of distributing the water so stored—expenditure far too great for the private individual. True, the schemes of diversion from our northern rivers, so much before the public during the past two years, are necessarily of such dimensions as to involve costs within the powers of the Government only; but, even then, what are the limits of these schemes? In a moderately dry year, less than 7 per cent. of the rain falling in the northern parts of the State reaches the river-channels. Of this, some must be allowed to pass for the use of the other States, and as the rainfall in the north is, in such a year, in excess of requirements over a very small portion of the area, it may readily be concluded that the area capable of being served by these schemes is after all of no great extent. The total area which may be expected to receive irrigation in one year cannot, as a matter of fact, much exceed one million acres. Assuming that in an irrigation district not more than one-third is irrigated annually, the State schemes of irrigation will only account for three millions of acres out of the fifty-six comprised in the State. No one acquainted with the possibility of our farming districts will regard this as our ultimate limit of irrigation. Each farmer can carry out for himself works providing some small amount of

HILL-TOP DAM.

irrigation, utilizing for that purpose water which otherwise would have been mainly dissipated in the air without going into the ground for use by the plants. Given favorable conditions, the benefit—actual cash returns—which can be obtained from small quantities of water carefully applied is almost incredible. One of the "Closer Settlement Studies," by the Director of Agriculture, dealing with the Flora Hill Dairy Farm, near Bendigo, shows strikingly the value of irrigation on a small scale. Later on in this article will be shown how the orchardists of Doncaster make great profits out of water, while other instances of dairy farms might be cited.

Irrigation may mean either supplementing a rainfall deficient for the whole year, or simply giving the plants water during dry periods within the year. In the first case, the water used must, of course, be caught off land which is not cultivated, while in the latter the land actually being irrigated may yield from the excess rains of the wetter months sufficient water to tide over the trying intervals in the drier part of the year. It may be employed either for increasing the returns obtainable under ordinary conditions or for obtaining yields not otherwise possible. It must be borne in mind that the heavier the crop the greater the volume of water required, as the leaf surface or evaporating area is roughly in proportion to the yield. A fairly heavy crop of hay or grain will require for transpiration through its leaf surfaces the equivalent in water of 12 inches in depth. Transpiration is continually going on; but is, of course, greater in the drier months. Hence the moisture of the wet months must be stored for the requirements of the drier. Fallowing, with subsoil stirring, and frequent harrowing of the surface, will conserve and carry forward much water from one season to the next; but these methods cannot obviously be applied to perennial crops. These crops must in almost all parts of the State receive a greater or less volume of added water to insure profitable returns. The volume of water to be added cannot be stated exactly; local conditions so influence requirements, and are so variable, that only indications can be given the grower, who must ascertain for himself the correct quantities. As instance of the extreme variation in this respect, the Mildura fruit-grower gives his trees 24 to 30 inches during the year, while, for similar trees at Doncaster, not more than 2 inches are added in ordinary seasons, and nothing in exceptional ones. Near Bendigo, 7 inches has been found sufficient in a dry season to produce heavy summer fodder crops, while in the southern districts a somewhat less depth is sufficient for similar purposes. For perennial fodder crops, such as lucerne, an almost unlimited amount of water may be given, 36 inches for the year not being excessive. Cereal crops, though grown in the moister months, require, from the practical difficulties in the way of economical distribution, from 6 to 12 inches, or even more.

Applied to cereals irrigation on the small scale will rarely repay the farmer; the profit on these crops being small and the necessary areas large. The right kinds of crops for irrigating are fodder—for dairying purposes and generally to make ensilage, and fruit trees—especially when near large towns which afford a ready market for fresh fruit. In the more arid of the northern and north-western districts, and especially in the Mallee, the value of a small quantity of irrigated green feed for the working stock is very great from a medicinal point of view, while the health of the farmer himself and his family is greatly improved if fresh vegetables are obtainable on the farm. It is not a matter of much difficulty for the farmer to irrigate close upon one acre of green feed—maize, amber cane, lucerne, &c.—and vegetables: all that is required is an extra thousand cubic yards capacity in his tank. This can easily be filled if channels are near, or from most catchments if properly improved.

With irrigation, as for all good cultivation, drainage is essential. In many of our northern soils, the natural drainage is sufficient; but in some cases, and in most of the southern soils, artificial drainage must be resorted to in order to secure the best results. This may be effected in any of the ordinary ways. For orchards, the agricultural drain-pipe system is about the best. Careful attention must be paid to the soil, and especially the subsoil, when fixing the depth and distance apart of the drains. Drainage of land is a big subject involving many considerations, and needs dealing with in a separate article. Stirring the surface of the soil as soon as possible after a watering is also essential, to prevent evaporation and conserve the moisture. Irrigation and continual cultivation are inseparable to insure success.

GENERAL VIEW OF DONCASTER DISTRICT.

Australian conditions differing so greatly from those of the old world, whence came our first farmers, have compelled the adoption of agricultural appliances and methods peculiar to the southern continent. The stripper, harvester, stump-jump plough, and other implements can be cited in support of the statement as to appliances, while a notable instance of localized methods occurs at Doncaster, the well-known fruit-growing district, lying about 10 miles north-east of Melbourne. Here, a system of partial irrigation by small dams of limited catchment has converted a somewhat precarious industry into one of large profits. That peculiar local conditions—conditions rarely occurring in the State—contribute to this result may be granted; these will be referred to later. Doncaster, and its surrounding district, is undulating and, considering its proximity to the sea, is at a comparatively high elevation. Its altitude is, in general, 400 feet; towards Mitcham and Ringwood as high as 500 feet is reached. In its unimproved state, the land is densely timbered with stringybark, apple, and other gums and numerous wild cherry trees. The grasses are coarse, and the soil generally inclined to be sour. From the pastoralist's or the ordinary farmer's point of view, it may be classed as distinctly inferior land. The general formation is silurian—until recently better known as upper silurian—the rock mass occupying that portion of Victoria lying between a line running northerly from Melbourne and the sources of the Goulburn, Yarra, and Macalister Rivers. The Sale railway line runs along the southern boundary, while the northerly extensions range from Rushworth to Benalla. Just at the village of Doncaster, where the famous tower stands, a prominent landmark for miles around, there is a patch, of no great extent, of tertiary sands, clays, and conglomerates. It forms one of the remaining portions of the extensive tertiary plain once covering nearly the whole of the Melbourne district. Silurian areas have generally better soil than appearances would lead one to judge, and, compared with other than tertiary districts, are fairly good grazing land. The main characteristic of the silurian rock is a generally loose structure near the surface, it being much jointed. The surface soil is usually shallow, resting upon clays—formed from decomposition of the rock—containing numerous angular quartz fragments from quartz veins and pieces of rock not yet decomposed. The clay is of no great thickness; apparently a matter of little moment, but therein lies the explanation of the special need for irrigation in this district. The subsoil is not deep enough to retain sufficient moisture during the months of great evaporation—November to April inclusive. The water percolating to the rock is practically lost owing to the open nature of that formation. When periods of drought occur long enough to permit of the greater part of the moisture reaching the rock, watering must be resorted to if the trees are to be kept vigorous and their yields not affected.

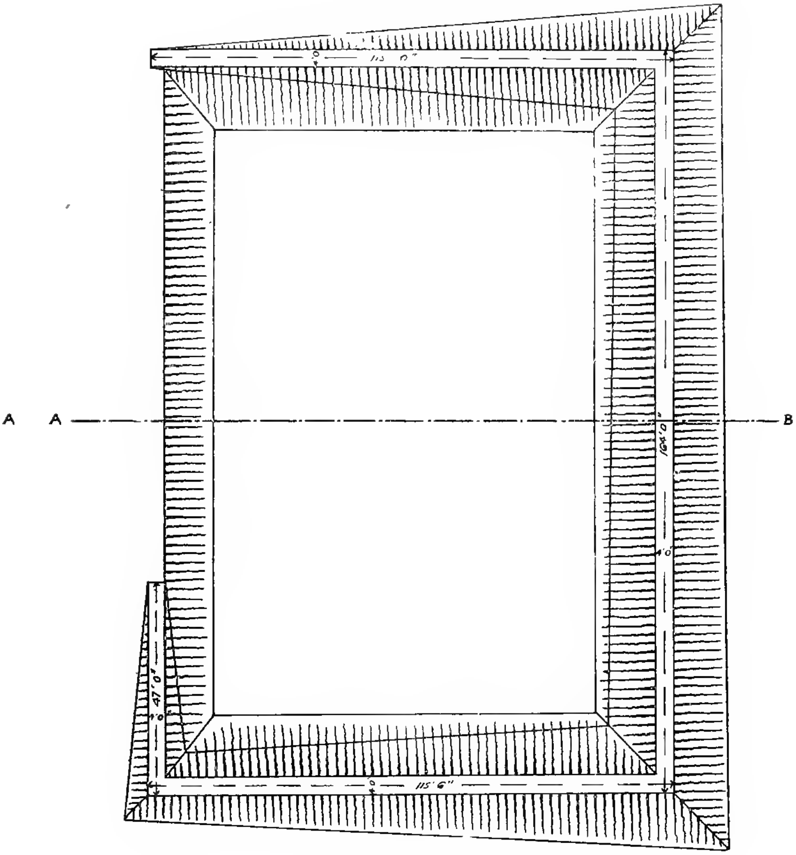
The rainfall in the Doncaster district is heavier than that of Melbourne, which is a little over 25 inches. No returns for Doncaster itself are available. Records of the rainfall at Box Hill and Blackburn, although not covering sufficient periods to give a reliable average, point to an annual rainfall at Doncaster of slightly over 30 inches. Judging from records at the Melbourne Observatory extending back 49 years, its average distribution throughout the year is surprisingly uniform. The following table gives the mean daily fall in each of the twelve months of the year at Melbourne:—

	Daily average.	Monthly average.		Daily average.	Monthly average.
January	.063	1.96	July	.059	1.83
February	.064	1.79	August	.059	1.82
March	.069	2.13	September	.077	2.31
April	.081	2.43	October	.087	2.71
May	.069	2.14	November	.076	2.27
June	.070	2.10	December	.071	2.21
Whole year	.070	2.14	Whole year	.070	2.14

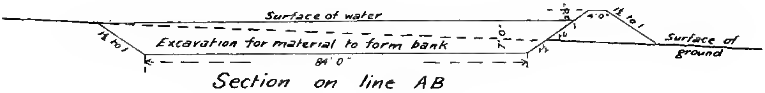
Annual average ... 25.70

The regularity of the distribution throughout the year is striking, and if it were always so the necessity for irrigation would not have arisen. The rainfall, especially in the dry months, is, however, subject to great fluctuations, and it is in these months—when evaporation is at its highest—that the plants require the greatest quantity of moisture. As the subsoil is apparently unsuited for storing sufficient of the surplus from the wet or

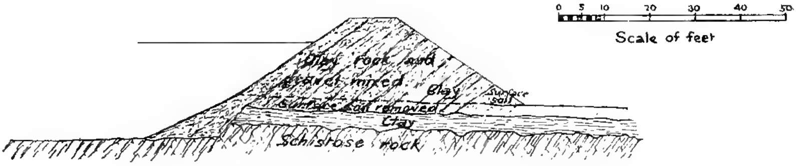
Hillside Dam



Plan



Section on line AB



Enlarged section of bank showing its construction cereal-growing months, the fruit-growers have recourse to stored water at times of drought. The stored water in most cases comes off the orchard itself, and is returned to the soil as needed, generally between the end of November and the end of March—in not greater volume than 2 inches in depth per acre.

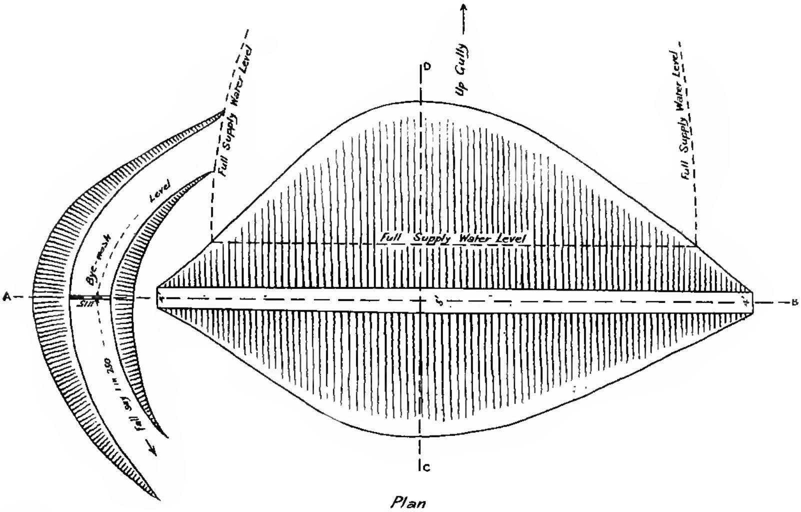
The practice of irrigation at Doncaster is not confined to a few enthusiasts. The system of small dams is almost universal, as will be seen from the accompanying map of a portion of the Doncaster district. Almost the whole of the land is under horticulture, and the district is dotted with dams. The orchards generally are small, and, of course, many of them are without gullies. Consequently catchments are limited, and of poor quality, while economical sites for storage are rare. Restricted as the catchments are, they are all cultivated—land being too valuable to be allowed to lie idle—and their run-off is, in consequence, small. In some cases a few chains of road running alongside the orchard is all that is available; yet with the small volumes used, and the economical methods of distribution employed, they suffice.

HILL-SIDE DAM.

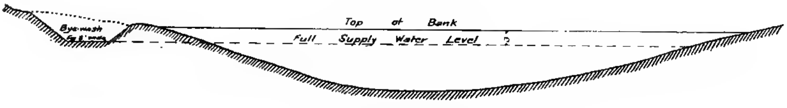
The type of storage generally adopted may be termed a "hillside dam." Its general arrangement will be better understood from the accompanying sketches showing the plan and sections of a typical case. The storage is partly in excavation and partly in fill, the material excavated is used as embankment to retain water above the surface. Owing to the lack of gullies the ends of the bank have to be returned to the higher ground—as shown in the figure—to retain the water in store. The bank, rarely more than 8 feet in height, and retaining about 6 feet of water above the surface of the ground, departs from the usual type in many respects, notably slopes and manner of construction. The inner or water slope is generally as steep as 1½ to 1, that is, one and a half feet diminution in horizontal width for each increase of one foot in height, while the outside slope is sometimes steeper, approximately to 1 to 1. Crest widths are generally small, 3 to 4 feet being the rule. The slopes mentioned, particularly the water one, would be unsafe in most soils, especially those of a clayey nature;

but here, as the dams themselves witness, the material permits the employment of such extreme batters. The explanation is that, by the method adopted for building, the inner face is composed of stuff taken from the deepest part of the excavation, which is largely rock, only slightly decomposed and full of quartz fragments. Where such is not the case the slopes have to be much flatter, or otherwise there is constant trouble and expense in repairs, not to mention the loss of valuable water. In construction, the seats of the banks are ploughed and the surface soil removed. It and the surface soil of the excavated portion are placed at the outer toe of the bank (see enlarged cross-section); the stuff beneath is then excavated and built in steep sloping layers as shown. The last layers which form the whole of the water-face are, as already explained, taken from the bottom, and become practically a slant puddle wall, not only to the bank, but to the slope of the excavation as well. This method of building is highly suitable to the local conditions; the rock into which the dams

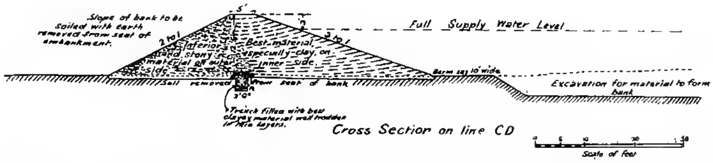
Gully Dam



Plan



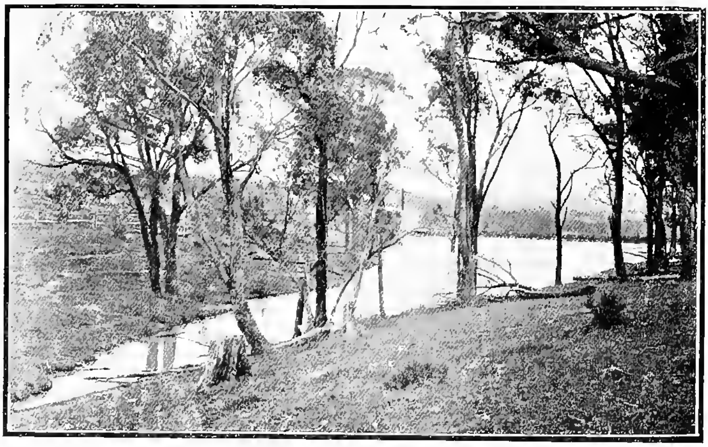
Sectional Elevation on line AB


Slope of bank to be soiled with earth removed from seat of embankment.
5'
Full Supply Water Level
2 to 1
Inferior and stony material on outer side
Best material, especially clay, on inner side.
2 to 1
Berm say 10' wide
Soil removed from seat of bank
3'0"
Excavation for material to form bank
Trench filled with best clayey material well trodden in thin layers.
0
5
10
20
30
Scale of feet

Cross Section on line CD

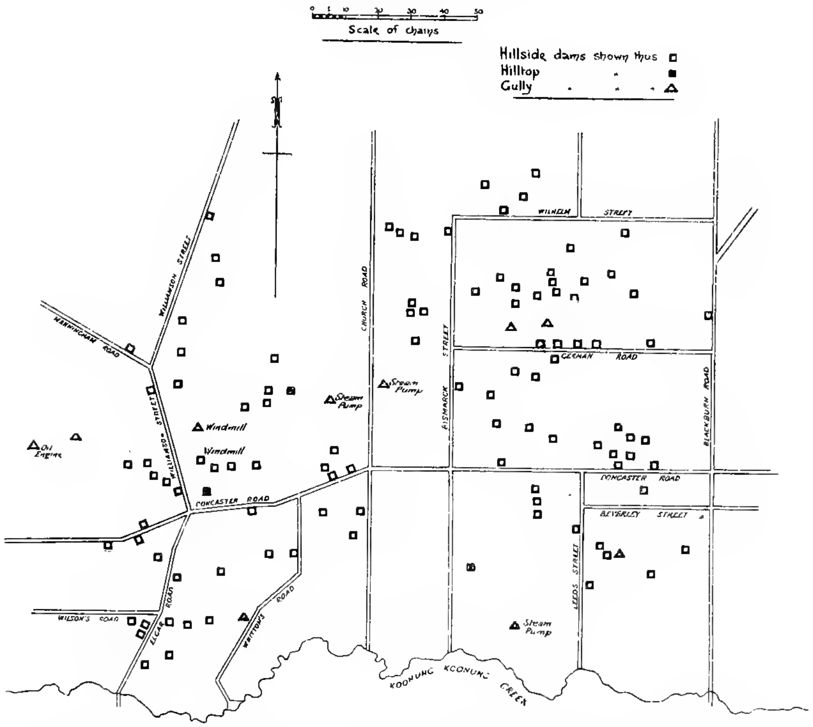
must for the most part be sunk being, as said before, very open, requires facing or puddling to make it watertight. The rock itself is really more dangerous to the efficiency of the storage than the banks. Outlets are composed simply of pipes, wrought-iron galvanized, of from 2 to 3 inches diameter, placed in trenches cut down to the lowest level of the excavation and refilled with clay.

Of similar construction are the "hill-top" dams or tanks. They are necessarily embanked on all four sides, and, having no catchment, are filled by pumping from "hill-side" or "gully" dams. They are but few in number, and are used only where it is impossible to have a "hill-side" dam with its own catchment at a sufficent elevation to command the whole of the orchard. "Gully" dams are also not numerous. They are principally used to pump from into hill-top dams, and occasionally into hill-side dams used as pipe-head basins. Owing to their unavoidably low positions and to the small areas held by each proprietor, they can seldom be used for gravitation direct. The "gully" dam embankments are built in horizontal layers with ploughing and surfacing of the seat. They have steep slopes, as in the case of the hill-side dams, without generally the same justification. They, however, seem to stand well, although, in one instance, the height of bank is as much as 25 feet, and their owners feel quite confident as to their stability, no matter what criticisms are offered. The by-washes are small, but so are the catchments.



GULLY DAM AND STEAM PUMP.

The water from the hill-side or hill-top dams is distributed by wrought-iron galvanized tubing, generally from 3 inches to 1 inch in inside diameter, branches as small as $\frac{3}{4}$ inch being rarely used. The pipes are generally bought second-hand at reasonable rates. Should the piping be bought new, care should be taken that heavy-weight pipes are procured as there are many light-weight brands in the market. The additional weight costs but little more, while it increases the life of the pipe in a much greater proportion. Piping is laid throughout the orchards with stand-pipes, closed by screw plugs at convenient points. Very few stop-cocks are used, nor are they needed. From the pipe outlets the water is sometimes distributed through hoses—old fire brigade hose being favoured on account of its cheapness—and, in other cases, by ditches and furrows. The ditches are short, rarely as much as 3 chains. When the ground is particularly porous and carries water badly, galvanized down-pipe—a metallic hose, in fact—is used. Water is delivered close to the tree, and the distribution being closely watched, is conducted very economically. As remarked above, the depth of water put on during the whole season is not more than 2 inches. In some seasons, such as the summer of 1903, no waterings at all were made. In laying out a system of distributory pipes, the following facts will be of service:—If the average fall per chain is 1 foot, which is obtained by taking the total fall from the surface of water in the dam to the outlet and dividing by the actual length of the pipe to that point in chains, a 3-in. pipe, in fairly decent condition, will deliver about 2,000 gallons per hour, that is, 1 inch deep per acre in 11 hours. With four times the fall mentioned, the delivery would be doubled, and with one-fourth the fall it would be halved. Under the same conditions of pressure and corrosion, one 3-in. pipe will supply as much as three 2-in. pipes; each of which will carry a little more than two 1½-in. pipes or as much as seven 1-in. pipes.


Portion of the Doncaster District showing Dams

The dams contain in store about a quarter of a million gallons on the average, a volume equal to the irrigation of 10 acres 1 inch deep. The excavation is about 600 to 800 cubic yards, the dams storing as much above as below ground. Pumping is effected by steam, oil-engine, and windmill plants. In general, reliance is chiefly placed on the hill-side dams, as there are in the whole district only four steam, two oil-engine, and four windmill plants. None of these merit description, being all of ordinary type and fairly effective. The farmer desiring to instal a pumping plant cannot do better than consult one of the well-known Melbourne or up-country firms who make pumping their special business. He has only to state all his requirements, and the particular conditions of his case, to get sound and reliable advice, proposals, and estimates.

In the Doncaster district, citrus trees are quite unprofitable without the small amount of irrigation described, while with it returns average up to 800 cases per acre, at from 5s. to 10s. per case. Lemons return about as much in bulk, but prices generally rule considerably lower. In deciduous fruits the increase in yield is not so marked, but still the profits are much greater with a little watering. Strawberries are also found a remunerative crop, but require much more water. Enough has been said to show that the Doncaster system of irrigation is profitable. Its general adoption proves that.

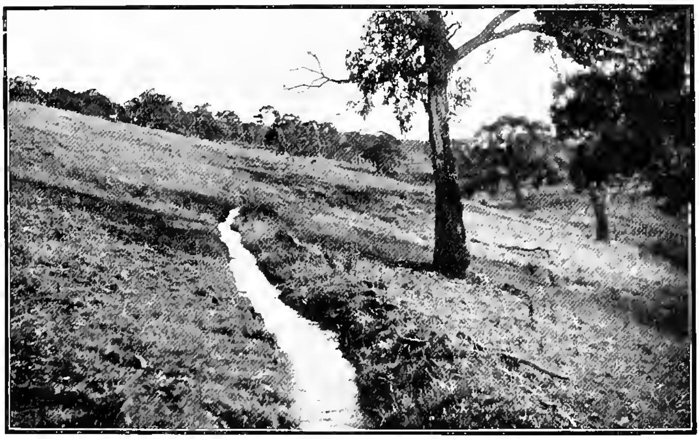
GULLY DAM. LOOKING DOWN STREAM.

An excellent example of irrigation on the dairy farm is to be found near Melton. Here, Mr. Grant, by means of two gully dams, irrigates very thoroughly about 30 acres of maize and lucerne, which, besides being used for green feeding, is made into ensilage on the most approved methods. The contents of the two dams are about 15,000 cubic yards, or 2,500,000 gallons of water. The depth of watering is between 5 and 6 inches, and is distributed by furrows and by checks. These dams are well made, and are more in accordance with the general practice than those at Doncaster. The accompanying photographs show the dams with the outlets, by-washes, and the ditch.

In determining to go in for a small amount of irrigation, the farmer must, as a preliminary, closely investigate his water resources. He must remember that intense culture demands very considerable volumes of water as compared with the requirements of his working and grazing stock. The irrigation of one acre will take as much water as will supply for domestic and stock purposes an ordinary farm. Should he decide upon a gully dam—generally the most advisable type—he must select a site suitable for cheap storage if such be available. At the site of the proposed embankment the gully should be narrow with steep sides; it should widen out above and be as flat as possible. The foundation must be good, for if any great depth of water is to be stored, good material in the foundation is essential. The character of the foundation should be ascertained by sinking pits. Sandstones, schists, and slates form the best material; clays of good character are nearly as desirable, granites and basalts are suspicious, having frequently clefts or seams running down for some depth. Sand drifts or gravels must cause the rejection of the site. By-wash accommodation is a feature requiring attention. If a saddle exists across which the overflow can be turned into another gully, all the better. The by-wash should be kept as far from the dam bank as possible. After final adoption, the site should be levelled and pegs put in across the gully on the centre line of the dam at frequent intervals. The section of dam bank which should preferably be adopted is illustrated. The front slope should be three to one; slopes steeper than this are liable to become sodden and slip, especially if much clay enters into the composition of the bank. The outer slope may be steeper than two to one; but the saving is little, not enough to justify the risk. The crest width will vary with the height of the dam. It should not be less than 4 feet for 6 feet height, and should increase 1 foot in width for every addition of 3 feet to the height. The crest of the dam should be 2 feet above full supply water level for small dams, and up to 4 feet for big ones. Having the levels across the gully, it is an easy matter to set out the toes, both inner and outer of the bank. This is necessary, as the first layers must be put on the full width if a good job is to be made. The first operation is to plough the surface soil for the full width of the bank between the toes. This soil is stripped off and put aside. The depth to be taken depends upon the locality; it should

GULLY DAM WITH BY-WASH.

be down to fairly good holding ground. A key-trench, as shown, should be cut along the centre line down to the clay or the rock, and should go a little way into it, 1 foot for rock and 2 feet for clay. The trench should be filled in with the best clay procurable, put in in 6-in. layers, wetted, if practicable, and well rammed, or, if space permits, well trodden by a horse ridden backwards and forwards. The clay should be brought up some little distance above the surface. The formation of the main bank is next to be undertaken. Earth excavated above the bank, keeping some 5 feet or so away from the toe, making the slope of the excavation flat, should be carted and spread in layers about 9 inches in thickness, the best material being kept to the centre, and the worst, stony or gravelly soil, on the outer slope. Carting or scooping should be done over the preceding layer as much as possible, in order to consolidate the material. On good consolidation and the prevention of creep under the seat rests the security of the bank. The younger members of the family may be profitably employed driving stock, sheep, or horses, backwards and forwards on the bank as it is being built. The layers should be slightly dished towards the centre. This feature is also shown in the drawing. Settlement, when the bank is so constructed, has the effect of consolidating the bank towards the inner portion and prevents cracks. It is well to allow, even when well consolidated, for further settlement at the rate of 1 inch per foot. Thus a bank meant to be 12 feet high ultimately will be built 13 feet in height. The by-wash should be opened up as the bank is being built, the material from it being run to the bank. It should be completed by the time the bank is up to full supply level, so that water may be passed through it in the event of a sudden flood. The bed-level of the by-wash will, of course, be at full supply level. The cross-sectional area should be sufficient to carry the heaviest floods likely to occur and yet leave from 1 to 3 feet at least of the bank above flood-level. The flood volume will vary with the extent of the catchment, its character, and its slopes, and upon the rainfall. If any indications of flood level are to be found in the gully the cross-sectional area should be measured, and a like area given the by-wash. Should there be nothing to guide the builder, the area, reckoned below flood-level, may be taken as equal to the square root



WATER CHANNEL, TOOLERN.

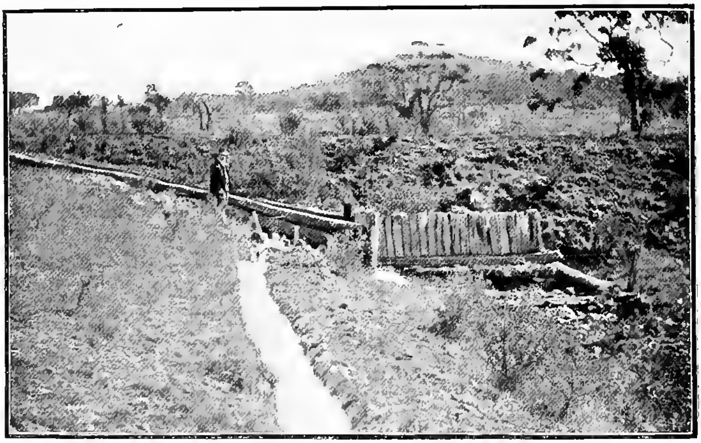
of the number of acres in the catchment area if the slopes be fairly gentle, and up to as much as four times this if the catchment has steep declivities and rocky surface. Thus, for an ordinary catchment of 100 acres, 10 square feet of discharging area, and for 500 acres, 22 square feet would be required. The entrance to the by-wash may be near the bank; but the return to the gully must be kept a considerable distance below the outer toe, or the scouring will endanger the whole of the bank. A log sill should be sunk in the by-wash, and some metalling or pitching put in the approach to prevent scouring and lowering of the full supply level. The return slope should be as gentle as possible, and should be logged or metalled. Drops may be put in if timber is plentiful. In the photographs showing Mr. Grant's dam from down stream, a good view is obtained of a log-drop by-wash, which is, however, too near the outer toe for perfect safety. The water stored in the dam may be let out by a pipe placed in a trench cut in the solid with wing trenches on both sides and below at one point to form a shield. Preferably, an iron shield, some 2 or 3 feet in diameter, should be fixed on the pipe. A valve can be put on the down stream side to control the flow. In many cases a siphon outlet will serve; it can be constructed with less trouble than the pipe outlet, and is not a source of danger to the bank. The siphon requires an aperture at the top for filling, and a plug or valve at the lower end to retain the water until the aperture is closed. The outlet must be considerably lower than the bottom level of the dam to give satisfaction. The finishing touches may now be given the bank. The soil stripped from the surface and put aside should be spread over the outer slope to promote a growth of grass, which will protect the bank from scouring by rain. If stone is easily procurable, the inner slope may be metalled or beached up to flood-level to prevent washing down by wave action.

Hillside dams should be constructed on like lines, except that a by-wash will not be required, any surplus water being allowed to pass around the ends. Notwithstanding the Doncaster practice, the farmer will be well advised to stick to the slopes given, and the horizontal layer method of construction, if he desires security. Excavated tanks will rarely be used for anything but irrigating produce for personal use, so need no description here. Overshot dams or weirs are only required on fairly large creeks or rivers, as by-wash dams will serve on the smaller water-courses. The impounding of the waters of a creek by means of a weir will generally be beyond the power of the farmer; and would, in addition, bring him within the purview of the Water Commission under the new Water Act. Water for irrigation may be obtained from wells in certain cases; but, as a rule, the lifting of the water is too costly, while the water is generally seriously contaminated with minerals, too much so for the health of the plants. Unless at or near sea level there is little chance of artesian water, and, even then, the same objection as to well water applies.

The water from the storage may be conveyed in pipes or channels to the cultivation paddocks or orchards. If in channels, they should be well graded, having a fall of not more than 4 feet per mile or about one-half inch per chain. They must be kept clean and free from all growths. Even with these precautions the losses of water from small earth channels will be considerable. It may pay to line them with cement or lime concrete. Channels may have their holding capacity improved by banking up sections and puddling clay in the standing water. The lining of a channel considerably increases its discharging capacity. The following table gives some capacities in inch acres per day of various sized channels with ordinary falls, both lined and unlined; the side slopes are taken as one to one:—

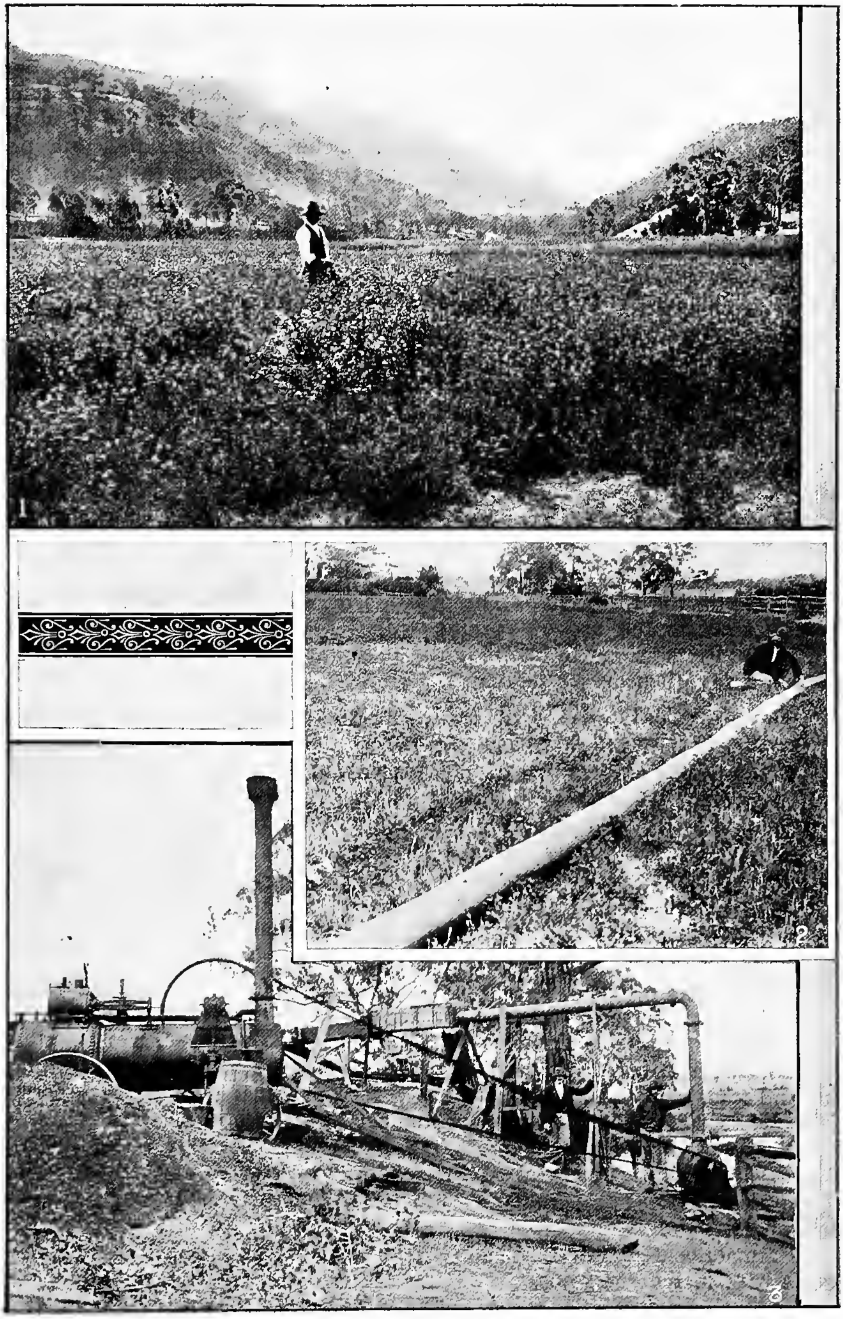
Bed-width in feet.		One.			Two.			Three.			Four.		
Fall in feet per mile ...		1	2	4	1	2	4	1	2	4	1	2	4
Depth, one foot	lined ...	64	93	133	109	157	225	155	224	320	204	294	460
	unlined...	22	31	44	37	55	76	53	77	110	69	99	145
Depth, two feet	lined ...	279	404	576	412	592	844	550	794	1130	701	1005	1429
	unlined...	97	141	203	141	204	294	196	284	408	250	359	515

If the fall of the country is greater than 4 feet to a mile, drops should be built in the channel so as to reduce the channel grade to 4 feet. Outlets may be made of boards nailed together to form a square pipe; on the inner side a sliding wooden or iron door, with the help of a shovelful of dirt, will keep it shut. The size need only be small, some 2 to 3 inches square. In crossing gullies flumes may be used, though as a rule a pipe siphon is cheaper and more effective. Flumes may also be used in very porous ground instead of lining the channels.



OUTLET SLUICE.

The ground to be irrigated must be well prepared. Subsoil ploughing is advisable, and the working of the soil should be thorough. All the hollows should be filled up by scraping down the bumps. The extent to which grading of the land is feasible is limited, however, by the depth of the soil. It is not an advantage to shift all the fertile soil of a patch leaving the hungry subsoil exposed. Before grading, the levels of the paddocks should be taken, so that the position of the commanding channels and subsidiary drains may be set out, or if flooding irrigation as for lucerne is the object, the locations of the check banks may be made. Methods of



1. LUCERNE PADDOCKS, BACCHUS MARSH.
2. IRRIGATING LUCERNE WITH CANVAS HOSE.
3. PUMPING PLANT FOR IRRIGATING LUCERNE.

obtaining the levels for this work, and for dam banks laying out, will be given in a subsequent paper on surveying for the farmer. The main or commanding channels should run between banks as much as possible, so that the water may be easily drawn off. The minor distributaries will be some chains apart, and will deliver into checks. Check banks should be about 6 inches high, and should hold about 4 inches of water; they are put in whenever the ground has fallen about 3 inches. When each check has been filled, and sufficient time allowed for the soakage, the bank is cut and the water allowed to drain into the next one. Water should not be allowed to stand on any land for more than twenty-four hours. More rough and ready methods are often practised. Grading is not attempted, and check banks are few and far between. The results are never satisfactory; not only is water wasted, but actual damage is done and losses incurred where profits, and large ones, should be obtained. In orchard work, the water should never be allowed to spread over the surface. Furrows are run down each side of the rows of trees, and the water from these soaks laterally and downwards into the soil. The soil is cultivated as soon afterwards as can be done. In many cases hoses, as already referred to in connexion with the Doncaster irrigation systems or flumes, are used to further economise the water. At Bacchus Marsh, on the highly absorbent river flat soils, some such means are compulsorily in use.

It will be observed that two differing measures of water volume have been used in the foregoing. The question of water measurements is much complicated by the use of varying units. Generally, gallons are better known and understood by the majority than any other unit. The following memoranda will prove of service:—

One inch acre = 3,630 cubic feet or 22,600 gallons, or 134 cubic yards, and weighs 100 tons.
One gallon = 4/25 or .16 of a cubic foot, and weighs 10 lbs.
One cubic foot = 6¼ gallons, and weighs 62½ lbs.
One cubic foot per minute = 1,440 cubic feet, or 9,000 gallons per 24 hours.
One sluice-head = approximately 22 cubic feet per minute, or 200,000 gallons per 24 hours.
One miner's inch = 1.4 to 1.8 cubic feet per minute, or 13,000 to 16,000 gallons per 24 hours.

The gallon referred to is the Imperial gallon. The United States gallon, often referred to as a gallon simply in works on irrigation, is one-sixth smaller than the Imperial.

Considerable information as to fodder crops, the mode of putting them in, and their watering, is contained in a very practical and useful paper by Mr. A. Baldwin, in the September number of the *Journal*.

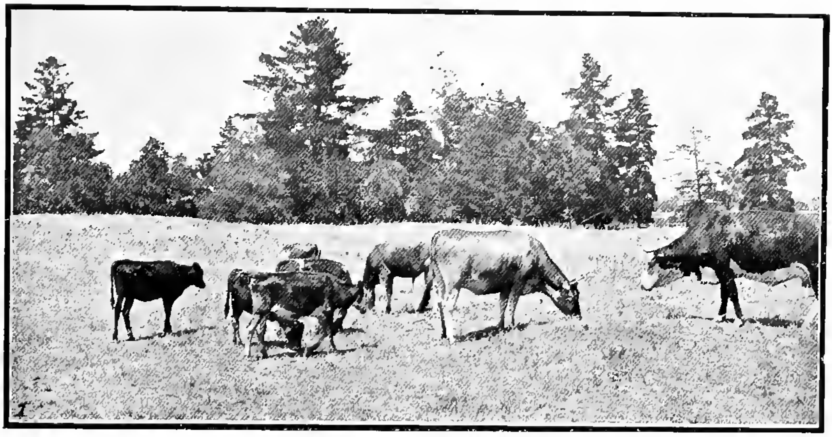
The photographs accompanying this paper were taken by Messrs. R. G. Macey and C. F. Thomsen, of the Victorian Water Supply Department. I am also indebted to Mr. A. F. Thiele, of Doncaster, for much valuable information and assistance.

Farmers contemplating irrigation will probably encounter difficulties not dealt with in the foregoing.

If any questions as to construction of irrigation works are sent in, they will be answered in the *Journal* if of sufficient general interest, or directly if of personal interest only. All letters should be addressed to the Editor of the *Journal*.

CHAPTER VI.

THE FARM HOMESTEAD.

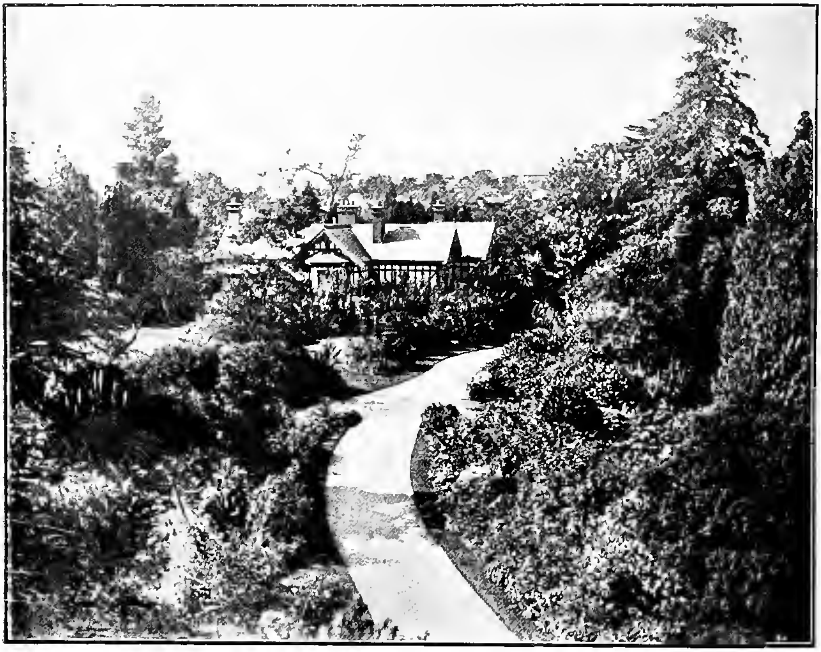


THE COUNTRY HOME.

For lack of plan many farms fail to pay. Order prevents waste, and to secure the highest average returns and live in solid comfort should be the aim of every one dealing with the soil. Under a sound system of farming the more land is cultivated, cropped, and stocked the better it becomes; but unfortunately, the reverse is the rule. To keep up the vitality of the land is, therefore, the land-owner's first consideration, since everything he would obtain for market must come directly or indirectly from the soil. The ordinary manurial elements of farm land come from three sources—(1) The refuse of animals; (2) The refuse of vegetables; (3) The breaking down of latent mineral foodstuffs in the soil. But there is no comparison between the value of these, animal manure being infinitely more helpful to land and crops of all kinds. Now, since land is of varied depth, character, and quality, and subject to varied influences in the way of climate the world over, it follows that there can be no common way of dealing with or laying out the homestead. Still this foreword is necessary, since the plan of the farmer's home should ever be in agreement with the wants of his land. The soil must be the first thought, as where paddocks are well planned, graded, ditched, drained, and manured, the highest return may be looked for. Our country is so vast and varied that whole regions are devoted to a single industry, as wheat, or sheep, or dairying.

In rare positions and circumstances a single product as potatoes, onions, oats, or maize, may be grown year after year over a whole farm with marked success; but as a rule this is impracticable, and, even where possible, highly injudicious. In a general way mixed farming pays best for the reason that it goes furthest towards keeping up the fertility of the soil, and, therefore, is always increasing its possibilities in the way of growing new things which may be in demand. We need a well-balanced farm—areas which will yield crops for animals, which will, in turn, provide manure for the most actively cultivated paddocks. If hay or wheat or potatoes are grown and sold off the farm, and practically no refuse returned by these, nor animals kept in any quantity on recently cropped land, it is bound to decline in value, even though the owner may not be wise enough to make the discovery.

A good farmer will, therefore, see that his farm is so laid out that every part of it stands related and helpful to each other. He will say, with so many acres fit for and best suited to the plough, I must have so many acres for stock and stock feed. This land will require on an average so many tons per acre of good fat manure, and I must keep animals to yield at least up to my calculation. If I can do this I am safe, for no man ever failed who had the means of manuring his land, and did it.



The Homestead.

This brings us to the homestead—the mental and actual manufactory of those materials which are to keep the farmer's land in heart and profit. He wants a home for himself, also for a number of animals, and proper protection and provision for many things which go to sustain the farm as a whole.

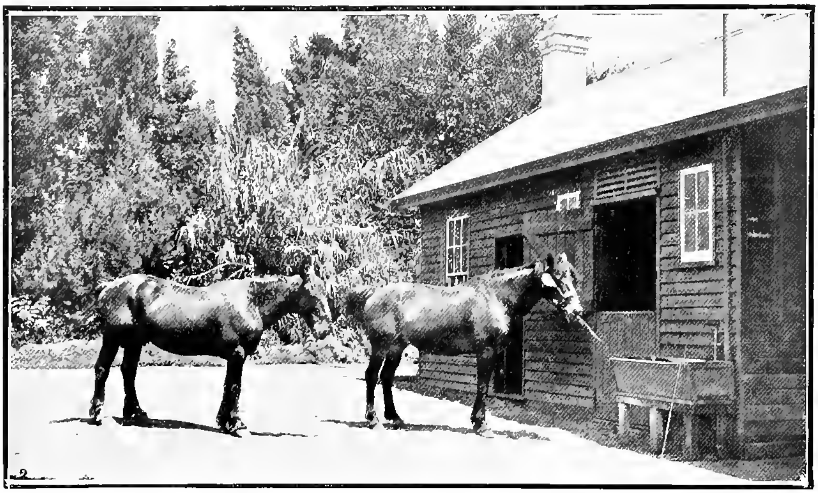
The position of the homestead is worthy of careful consideration. It should be on a well-drained site, screened as far as possible from heavy winds, and capable of receiving a good water supply from a surface flow or from wells. In flat and open country a raised platform should be provided on which to build the house and principal outbuildings, and this can be done at no great expense, and always to advantage by scooping a dam to secure material for the platform. The size of the homestead will depend on the extent and character of the estate, but in all circumstances the whole scheme should be studied together, and nothing left to a chance position.

The course of the public road, whereabouts of water, aspect, form and character of land, nature of the climate, and the most obvious branches of industry to be followed, will each and all determine on what part of the farm the homestead should be placed. If in a warm and hot-wind region the dwelling house and other buildings should face the east or south, whilst in cool or damp positions a northern or western aspect should be chosen. Other points which may be considered when choosing a site are the convenience for working the estate and the saving to be effected by diverting or storing water at particular points. Again, dry and exposed eminences, if chosen for houses and farmsteads, conserve no vegetation or manure, whilst land subject to flooding is often robbed of such materials as should go to enrich the estate. A pretty site may not be an economical one, but it is always well to avoid anything like an ugly or stupid position for the permanent homestead.

TREES AND SHRUBS FOR BEAUTY AND COMFORT.

As far as possible the dwelling should be kept above the level of the farm buildings, so as to insure perfect drainage and sanitation, and admit of all drains and domestic refuse finding a natural outlet in the farm manure pit. In building a new homestead or remodelling an old one, all essential wants must be enumerated. Buildings will, in all cases, include the farmer's house, and possibly a room or extensive building for farm hands, a stable proportionate to the size and nature of the farm, cow sheds, cow yard, and dairy, pig styes and yards, poultry house and run, and a barn and store room; a roomy and partly-enclosed cart and implement shed; domestic offices, a small house with copper and tanks for cooking and holding animal food, a chaff house, water tanks or a well, various stands for, and drinking troughs, a stock yard, one or more manure pits, a pond or dam, sites for wood stack, drying ground, flower and vegetable garden. All these at least will have part in every well planned homestead, where occupation is intended to be permanent.

The arrangement of the various items has now to be considered. The site of the house chosen, there should be the possibility of securing both front and side lines of approach. The size of the farm and nature of the work carried on at the homestead, whether many or few animals are kept, will decide the size of buildings, and so control the size of the yard or yards. Sometimes two or more small yards prove much more convenient and profitable than one big one. This is especially the case in dry and open country or where water is scarce. Animals are not rendered unhealthy by the presence of their own manure, and, in practice, manure pits should be convenient to stables, styes, and cow sheds. Bearing this in mind, one should group the buildings to save labour in housing, feeding, and cleaning, and also to conserve as far as possible every particle of matter which is likely to be of use to the soil.



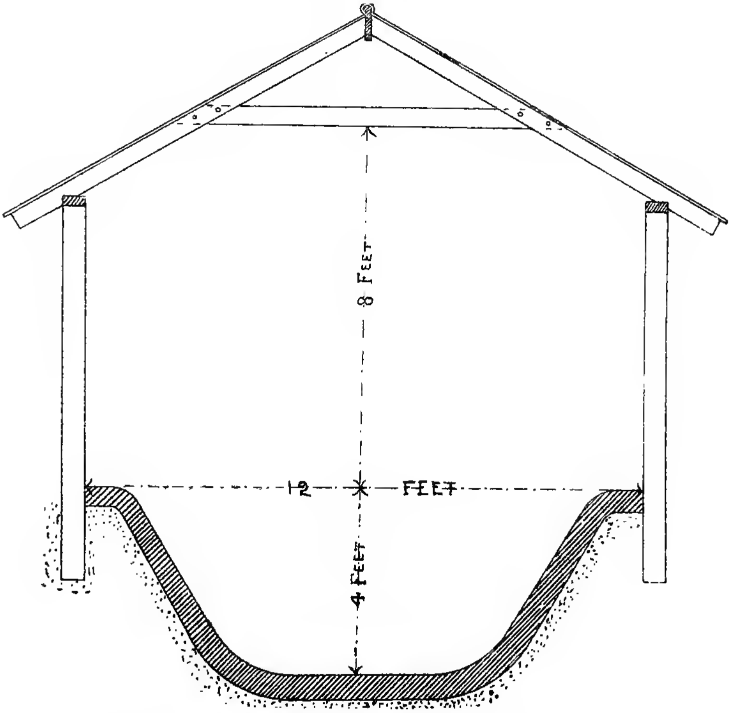
PROTECT THE STABLE AGAINST ADVERSE WINDS.

No absolute rule can be followed in the grouping of farm buildings, for in one place it may prove best to put them all together, and in another they may be cut up into three or four groups. The great thing is to reduce the danger from fire or flood, to protect against adverse winds, secure good drainage, get the manure, both liquid and solid, to travel to safe holding basins, secure easy method of working, neatness, and good order, and at the same time not run over too much ground. As much water as possible should be stored and under control, well above the level of the principal sheds, so as to provide for ample cleaning and the breaking down of dry

Missing Page

litter, which may furnish manure. No drains must carry liquid manure away from the farmstead, these should always be laid to conduct urine and yard washings to the various manure pits, of which there should be sufficient number to absorb all the refuse made from season to season.

In hot, dry, and windy positions the manure pits should be wholly or in part covered. The following is a simple and effective type of manure pit, easy to make and cart from, forms a foraging place for pigs and poultry, and preserves the highest value to all the matter placed in it:—

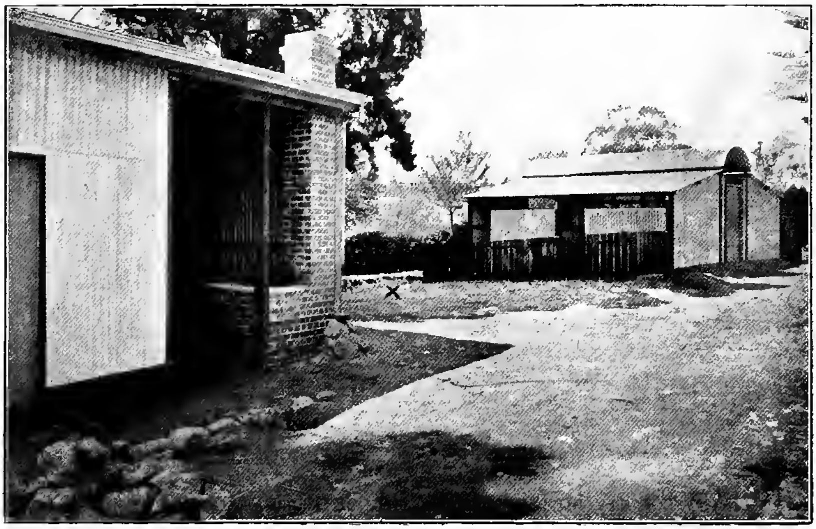


In clayey country no lining is needed; in loose porous soil a three to six inch lining of stiff clay will prevent the soaking out of the best liquid properties. In very loose material small stones should be placed on the sloping sides and floor, and the inter-spaces filled in either with clay, mortar, concrete, or cement. The sides are formed of two rows of strong posts, close enough to support the roof, which may be of any material which will serve the purpose.

Yet another part of the homestead has to be considered before determining the sites of the various buildings and conveniences, and that is the space to be devoted to shelter belts, hedges, and individual trees which will secure such beauty and comfort as to make it a genuine home. If possible some native trees should be left, as they not only prove attractive in themselves, but also furnish a screen, under the protection of which young plantations come on much faster than if fully exposed to all the winds that blow. Before decorating and improving the homestead by means of trees, consider what it is desirable to shut out and what to see. Distant country may prove more refreshing than a wall of green near at hand; peeps may be more beautiful than wide, open views. Air in motion is necessary to good health in the home, but hurricanes are not desirable. Plant trees by all means, but plant them where they will be of permanent interest and value, for it is a cruel thing, after waiting and watching for years, to cut them down because they are in the way.

Where dairying is to be carried on or a marked degree of cleanliness is wanted in some portion of the farmstead, a somewhat severe line should be drawn between the animal and other quarters. A stiff hedge or narrow belt of trees and hardy shrubs is often practicable where large home industries are carried on.

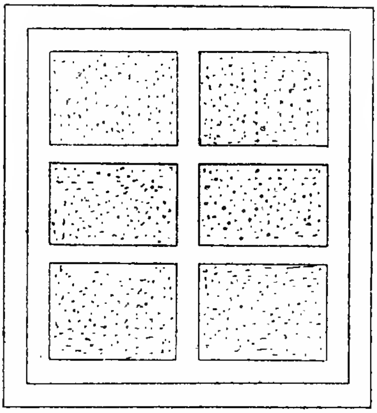
In spite of all we have said we are dealing with essentials, for the plan cannot be entered upon till we see our work and our wants whole and complete. As a preliminary, precise levels should be taken of all the land it is intended to include within the homestead. This will show what is wanted, and may be necessary in the way of drainage. It will also show what filling or excavating should be done to get safe levels. Having in the mind a more or less precise estimate of what is wanted, will enable the homestead builder to see the approximate sites for the various conveniences. He may decide to do but little at first but he must plan for all the future. A point arises here of which every farmer should take note. He must know for himself where buildings should stand, as neither architect nor builder may help him in this. Men with small estates and small means are their own architects and builders, and often display more judgment than those



BOILER-HOUSE AND MODEL PIG-STYE ON ELEVATED PLATFORM.

(X indicates position of manure-pit and drainage.)

who can afford to leave the designing and building to other heads and hands. These are usually too improvident. Structures good enough in themselves are placed among naked surroundings, so far apart that both land and labour are wasted. A really well conceived and executed homestead is rarely met with, though it is everywhere to be desired. In no case should there be profitless and untidy corners. The form of the land, nature of the water supply, and other uncontrollable forces will often compel one to scatter buildings, but the space between must not go uncared for, or heavy waste is bound to occur. All strips, corners and large spaces which cannot be avoided or utilized for any more definite purpose should be planted with trees. These will prove valuable in themselves, and add greatly to the appearance and selling value of the farm.

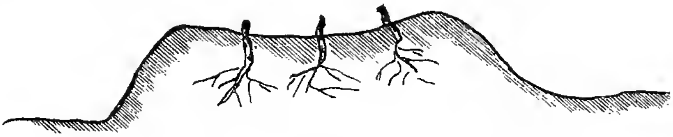


THE FARMER'S GARDEN.

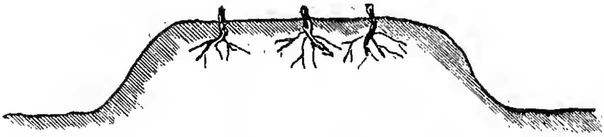
The size should be governed by the nature of the climate, as the hotter and more liable to drought the smaller it should be, since concentrated effort on a small area will usually produce more than a little labour, and practically no manure or water on a large piece of ground. The number of animals kept on the farm, the staff of employés, as well as the size of the family, are equally to be considered. Apart from the most favorable positions the farmer's garden requires to be made by bringing in large bodies of new soil and manure from outside. A deep, loose, rich, well-drained mass of earth is wanted in order to secure good vegetables at a low cost the year round. The plan should be quite simple, as where a great many paths and dainty beds are laid out there is no end to the work and far less profit.

For convenience in surface draining, wheeling manure, and getting at the various crops, have a 4-ft. path running right round at a distance of 3 or 4 feet from the boundary. The borders thus formed between path and boundary will serve for various herbs, salads, and such plants as thrive best under the protection of a wall, fence, or hedge. If the garden is over 50 feet wide, run a path down the centre, and make one or two side paths so as to break up the entire area into four or six blocks as in the above plan.

The various breadths may be subdivided and thrown together again according to the nature of the crop and the season; where water is scarce and soil dries quickly beds should not be very narrow or shallow, but thrown up into broad, deep ridges, with slightly hollowed surfaces, so as to hold all the water which may be given. The Chinaman—much as he is disliked—displays the highest intelligence and succeeds better than any European in the growing of domestic vegetables under adverse conditions of climate. With him it is not only more industry but more intuitive and applied knowledge of the art of compounding and shaping soil for the use of plants. The Chinaman may be studied with interest and profit wherever a permanent garden is desired.



SUMMER SURFACE OF VEGETABLE BED.



WINTER SURFACE OF VEGETABLE BED.

In the list of useful garden plants some are permanent and others have to be sown from year to year. The most valuable permanent plants are asparagus, seakale, and rhubarb. These will thrive almost anywhere, providing the soil is well prepared and enriched. Rhubarb should be planted in a shallow trench, as is done with celery, where the climate is very hot and dry, as the plant likes plenty of moisture and manure, and it is more economical to feed in a protected and cool trench than to mulch or water the open surface. All permanent plants, together with the necessary herbs—thyme, sage, marjoram, mint, horse-radish and parsley, should be kept to a particular block, normally that which is most protected and cool. Very useful all-the-year-round vegetables are silver beet, parsnips, carrots, onions, potatoes. In the late summer and early winter various kinds of cabbage and cauliflower, turnips and swedes, carrots and parsnips, beetroot and leeks, are set out to provide vegetables through the winter and over all or part of the ensuing summer. But on a large farm, or wherever animals are kept in appreciable numbers, a farm garden should supply many things for the home, and this will be found more profitable in every way than cultivating a large home garden by hand. Apart from ordinary grain and grass food, animals may be fed with maize, potatoes, artichokes, seakale, silver beet, peas, lucerne, beet, pumpkins, marrows, melons, rape, mangolds, swedes, turnips, and cabbage. Many of these (thirteen out of sixteen) will be found useful in the home, and more profitable when grown on the farm than in the garden. Onions should be grown wherever they will, as they are always in request, and any surplus at home can usually be sold at a profit. The leek, which is virtually a winter onion, thrives splendidly in Victoria, though it is a much neglected and most valuable vegetable.

The farmer of a large or small estate should take care to adjust his vegetable growing to the requirements of his stock and his home. If he sees clearly what the climate and soil—aided by his own energy—can produce, he will decide either for—(1) A small home garden, and farm garden; (2) A large home garden laid out to accommodate the plough; or (3) A home garden of a size in accord with the manure and water supply of a very dry district.

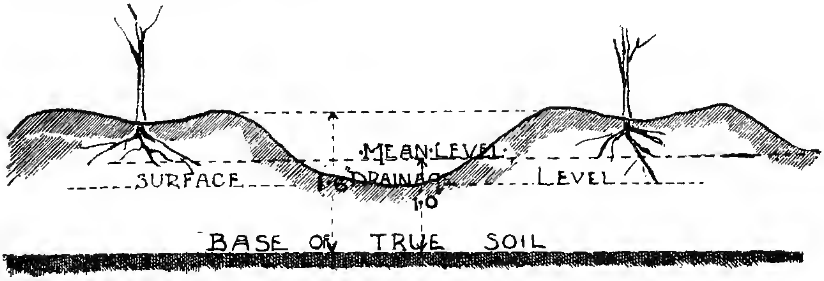
Vegetable seeds should be sown in Victoria somewhat as follows:—

Beans, French—September to February. Beans, broad—April to July. Brocoli—December to August. Brussel sprouts—November to February. Cabbage—February to August. Cauliflower—December to March. Carrot—March to September. Celery—September to March. Cucumber—September to November. Leek—April to November. Melons—September to November. Mustard—The year round. Onion—February to October. Parsnips—March to September. Peas—March to December. Potatoes—January to March (for autumn crop). Potatoes—June to November (for summer crop). Pumpkin—September to November. Radish—The year round. Spinach—August to May. Tomato—August to November. Turnip—Early spring and autumn. Vegetable marrow—September to November.

On small estates fruiting trees and plants are commonly grown to advantage in the home garden as they are not only highly decorative, but also add largely to the necessaries and luxuries of the table. But there are various reasons why fruit trees should be kept out of the garden when planning a new or remodelling an old property of any extent. This subject will be dealt with in another article where the farmer's orchard will have full consideration.

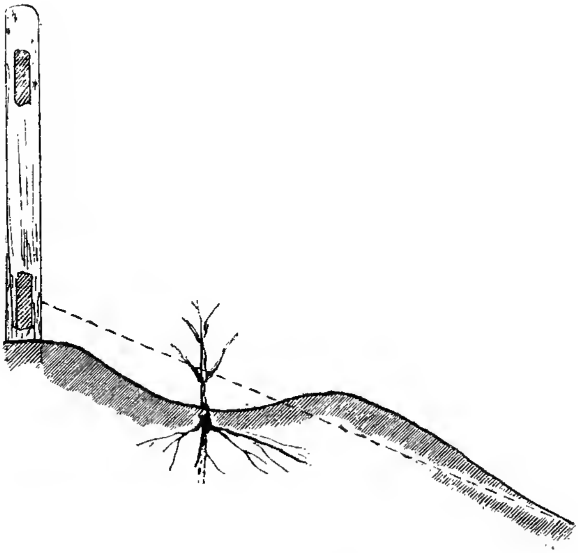
It remains only to be said that the homestead must be well supplied with trees and plants, which will furnish protection, beauty, and shade.

The first necessity in all open and hot positions is to stop the northern and western winds. Quick growing trees and hardy shrubs and stout hedges provide a screen within which it is possible to make and preserve an attractive and comfortable garden and home. Protective trees should be planted, but 6 or 8 feet apart. They will then form screens for each other, grow faster, and reduce the work of watering, mulching and general attention. Where water can be supplied by gravitation the surface soil should be arranged before planting clumps of trees or hedges. The following plan will show how to increase the normal depth of soil, improve drainage, and facilitate watering from any source.



The basin in which each tree is set may vary in width and depth according to the amount of soil and water available. It will be seen that the amount of permanently drained and aerated soil assured to the young tree will provide for rapid and strong growth, which is ever to be desired.

The following figure represents a hedge planted on top of sloping bank. The straight line indicates natural surface with no possibility of holding up water for use of roots. To give an actual experience the soil was ploughed out to form a ditch and bank, and water turned on from the top. A privet hedge in this position made about four feet of growth in one year.



The most important points in laying out the farmer's garden are—(1) Adding as far as possible to the natural depth and quality of the soil. (2) Providing good drainage. (3) Putting in plenty of shelter trees, shrubs, or hedges. (4) Limiting the paths to where they are actually and regularly necessary, since there is no beauty in earth paths, and the space they employ tends to hold up heat and leave the garden more exposed, and so rob it of moisture. (5) Turf borders or lawns should not be included, excepting where it is known that moisture is sufficient at all seasons, and that labour can be spared to keep it in order without neglecting more important duties.

When it is known what the position demands in the way of protection, shade, view points, or confinement, the convenient plan will or should promptly appear to the eye of those intrusted with the making of the country house garden. A front, side, and back entrance will call for at least three paths, two or more of which will meet to form a sweep round the most attractive part of the garden. Beyond these no paths should be thought of. The spaces lying between the paths, house, and boundary hedges or fences will fall into fairly large and graceful belts and borders, which will require filling with trees, shrubs, and smaller plants, according to their size, position, and the character of the country and climate.

In planting a garden where water, manure, and labour are not likely to be abundant, weakly and short-lived plants should be avoided, and those selected should be planted so close as to practically cover the ground at all seasons. Logs and stones may be used for the margins of paths, or border plants may be set where it is known they will thrive. Local material is nearly always to be preferred where buildings or erections of any kind are attempted in the garden. A summer house, bush house, rootery or rockery, arch or pergola (a covered way for vines, roses, and other climbing plants) look best if made of material in keeping with local surroundings.

To secure attractive and comfortable home surroundings by means of garden and garden plants, the following different groups have to be selected from:—(1) A sufficient number and variety of trees and shrubs to properly protect and improve the form of the homestead. (2) One or more kinds of hedge plant to divide domestic from farm quarters, and perhaps to make division between vegetable and flower garden and also boundary hedge. (3) A number of large shrubs, which are distinctly hardy, not prone to disease or needing much attention. These should furnish variety in the way of size, shape, or colour of leaf and flower, and season of display, so as to make them provide as a group, attractions the year round. (4) A collection of small shrubs to fill the spaces between the larger ones, and this second group of shrubs should be chosen on the same lines as the other. (5) A collection of climbing and creeping plants to cover stumps or posts, verandahs, untidy walls, odd corners which want brightening up, pergolas, arches, or trellising which may be found necessary. Grape vines, passion fruits, clematis of many sorts, kennedya, night shade, tecoma, bignonia, climbing roses, honeysuckle, rhyncospermum, white jasmine, ivy, virginian creeper, are all good and capable of thriving over the greater part of Victoria if care is taken in placing them in suitable soils and positions. Most climbing plants like shade, which implies cool and more or less protected soil. (6) A collection of small permanent flowering plants to brighten up points and the fronts of borders. These should be sufficiently numerous and varied in character to keep the garden bright at all seasons, whilst the ordinary crop of "annuals" may be relied on to yield a great deal of additional colour at particular periods.

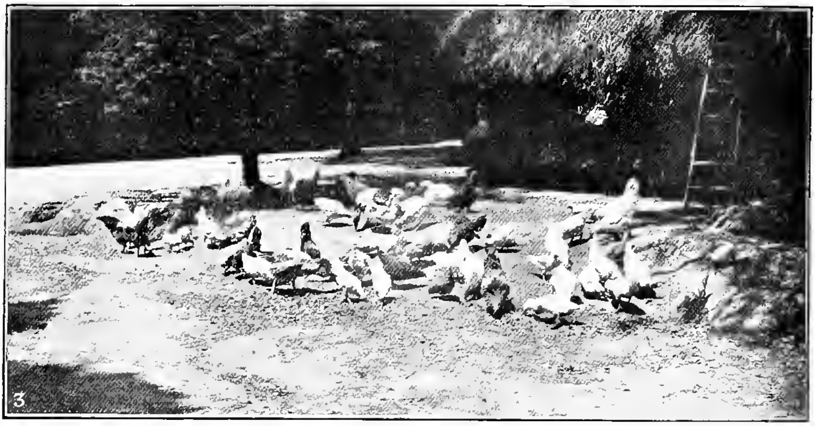
The surest way in ordering trees and garden plants from a nurseryman is to describe the height above sea level, the aspect, nature and depth of soil, proportion of summer to winter water supply, if little or much time to spare, so that a suitable group may be made in each class.

Out of these six groups, a garden may be made anywhere. The number and variety of each must ever depend on the size of the garden, and means of the owner.

To establish a good garden have no personal vanity or fad in it. Let it be a clean rich quantity of gracefully moulded soil, here and there run through with the necessary paths, and the rest covered with vegetation to produce the finest effect upon the senses. Every well planned and planted garden puts those who see it at their ease, whilst it adds greatly to the value of the remaining property. And no place is so small as to be unworthy of attention.

Wherever a home is intended, a garden may be made, since there is never a piece of country which is worth settling on but will provide the means for decent home surroundings.

The fault in Victorian country house gardens is that they are too big, open, and bare. It is not true that nothing will grow under trees. Almost everything that is wanted in a country garden will grow under trees, and, as a rule, infinitely better than in the open. Confine the garden, and enrich it by every possible means. A small space will then yield no end of comfort and pleasure at all seasons. What has been said here is fundamental. The farmer and rural settler has little or no time to bother about the names and sizes of particular flowers. He wants a home, a place of rest, and some prospect of his property increasing in value as the years go by; and what has been said here is all to that end.



A CORNER OF THE POULTRY YARD.

THE FARMER'S ORCHARD.

The size, plan, and contents of the farmer's orchard should vary according to locality, and the ordinary employments of the estate; but, before going into detail concerning the making of an orchard, we will consider its general advantages. In the first place, it adds greatly to the appearance and selling value of any property; it makes life more attractive; it reduces domestic expenses, and yields a profit on any surplus sold in open market; and further, it provides for a larger number of animals, and thereby creates manure and a richer soil.

The Fruit Zones of Victoria.

Before planting an orchard, the farmer should thoroughly understand his position as regards soil, climate, and the class of fruit which will under ordinary care thrive on his property. Victoria is too large for any one method of orcharding, or group of trees, to serve for all. We must therefore teach and practise by what may be called the *zone system*.

Victoria holds, roughly, four climatic zones:—I. The north-west, coming south to the line of Echuca. II. The north-central districts, south of Echuca, and running to the foot of the Dividing Range. III. The cultivated lands, lying above 1200 over sea level, and which are chiefly on the Divide and through Gippsland; and IV. The low coast country south of the Dividing Range.

These four zones offer very wide contrasts in the condition and general value of the soil when considered for different fruits. Fortunately there are fruits for all regions and soils, so that no one having a piece of land which is worth developing and converting into a permanent home need go without an orchard of some size and sort.

Groups of Fruit according to Climate and Position.

The first thing is to know the kinds of fruits suitable to the locality, and which are at the same time of use in the home as well as saleable. The various commercial fruits fall into three or four groups, each demanding a particular type of climate and mode of cultivation. The farmer in a hot or cold region, or one where the soil is rich and wet, or poor and dry over the greater part of the year, will require to take different species or varieties of tree as well as different ways of working to secure the common end—fruit.

The power of fruiting under adverse conditions and rough cultural treatment varies greatly in different trees—thus, pears are notoriously hardy, and plums and cherries seldom fail where they get sufficient moisture and a cool summer. The pruning of all these trees is of a simple character compared with what apples, peaches, and apricots require, so it will be seen that the orchard should to a large extent be in accord with one's knowledge. We must, therefore, take a group of fruits, and modes of planting, and caring for, appropriate to each zone. But before entering into local details it will be well to explain how land should be prepared, trees selected, planted, and cared for, to make them strong and profitable.

Points covering the Size, Class, and Extent of the Orchard.

The following rules are eternally and everywhere true:—

I. The hotter and drier the climate the deeper must be the soil.
II. The flatter the land the less it will yield.
III. The more unequal the soil the more irregular the fruiting.
IV. The wider the extremes of temperature the more risks in orcharding.
V. The more uneven the depth and surface of soil the worse the drainage.
VI. The worse the drainage the more uneven and inferior the crops.
VII. The more open the situation the closer the planting.
VIII. The scarcer the manure supply the smaller the orchard.
IX. The richer the soil the larger the tree's trunk.
X. The stiffer the soil the closer and deeper the furrows.

From these rules we may gather that every tree needs more or less light, heat, moisture, air, and sweet soil in order to make it strong, healthy, and profitable.

Orchard Management.

No one should think of planting an orchard who is not prepared to recognise that the trees will call for more or less skilful and constant attention. This is particularly true in the case of young trees, or where the soil is poor and dry, and the summer long and very hot. Taken as a part of a going concern, the feeding and pruning of the orchard can no more be put off than can the feeding and protecting of animals. To manage an orchard with success, one must be able to keep the soil in a free and wholesome condition at all seasons. Also know how to irrigate, manure, and prune, as each and all of these are fundamental to success.

The Orchard in the Hot, Dry North.

This should for various reasons be small. Of course, if water is available, and one has a special aptitude for fruit-growing, it may be made a feature of the farm. Half an acre, or say fifty trees, will, if well chosen and cared for, furnish a variety of fruit sufficient for the average family. The farmer will know that small blocks of land cost more in proportion to plough and care for than do those of larger size; therefore, it does not pay to fence in very small blocks where horse labour is expected to do most of the work. Again, if hand labour is to be employed, the land may be almost any shape; but it must be a more or less square and straight-forward piece of land if laid out for the plough, and especially if it is to be irrigated and ditched or drained as it ought to be.

CHOICE OF SITE.

In all hot and poor positions the best protected site should be chosen, also that which has the deepest and loosest soil. The extent should be governed mainly by the soil, position, and the amount of manure and feeding material obtainable.

FRUITS FOR HOT NORTH.

With or without irrigation, pears, almonds, peaches, apricots, grapes, passion fruit, oranges, lemons, will be found most suitable. These call for soil of unequal value, thus:—Pears, grapes, and almonds will grow in very poor and dry soil compared with what the others need. And remember, that though one mentions poor and dry soil by way of contrasting it with good material, no tree should be planted in a really poor or shallow medium in the region under notice. On almost every acre different materials and influences obtain, and trees should be arranged accordingly. Put pears, almonds, and apricots on the windy side, as they object least to the hot winds, and they will then furnish a screen for the peaches, oranges, and lemons, which need more protection. The vines and passion fruit should not be put in the body of a small orchard, as they interfere with its working; but, trained on the boundaries, they afford protection, and add greatly to the appearance and value of the place.

DISTANCES, KIND OF TREE, AND PLANTING.

The hotter and more exposed the position, the closer the trees should stand, since protection can never be furnished from the outside to the same extent as the trees may protect each other. For single horse work, 18 or 20 feet is ample distance apart in an orchard of small size.

Choose short-trunked one-year-old fruit trees, and make sure to have the ground ready to receive them on arrival.

Pears.—Williams' Bon Chretien, Winter Nelis, Josephine de Malines, Vicar of Winkfield, Beurre Capiaumont, Beurre Clairgeau. These are all found thriving in different parts of the northern districts, but six is too many for a small orchard, and the first three would serve very well.

Apricots.—Moorpark, Alsace, Hemskirk, Royal, are good, but the first two will be enough.

Peaches.—Briggs' Red May, Duke of Edinburgh, Amsden's June, Lady Palmerston, Hale's Early, Foster. These furnish fruit over a long period of summer, and may be put to various uses, as dessert, stewing, bottling, and drying.

Almonds.—Those of upright growth should be chosen for planting on the windy sides. Two sorts secure better setting and fruiting.

Passion Fruit are best raised from seed, first making up a rich, light border, then dishing the crown somewhat, and sowing the seed direct from large, thin-skinned, well-ripened fruit. They should stand three to six feet apart, according to strength of the soil, and be given something to climb over from the start.

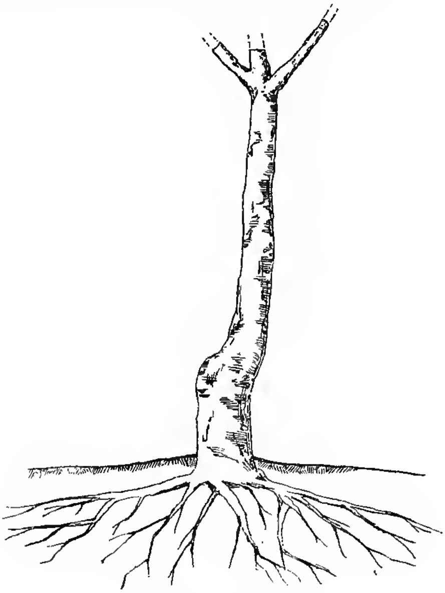
Grape Vines are easily established from cuttings a foot to eighteen inches long, placed at a long slope in the soil; but as the phylloxera threatens to overtake all our vines, it will be well, except in the most isolated positions, to obtain grafted vines from Rutherglen College. The vine on resistant stock calls for a much deeper and richer soil than the vine on its own roots.

Lemons.—The Lisbon is the best kind. Choose plants which have been raised from local "layers," or which have been "acclimatized" by the Victorian nurseryman. These and oranges also should arrive with balls of earth about all their roots. They should be kept damp during transit, and planted at once on a raised surface or mound at least eight or ten inches above the surrounding soil. The very richest and best drained position is necessary.

Oranges require exactly similar treatment to lemons. Good hardy sorts are Silletta, Mediterranean Sweet, Washington Navel, Seville (for marmalade).

PRUNING, MULCHING, PROTECTING, WATERING.

At planting take away all damaged roots, and if the root system is unequal, thin it to make each part do the same amount of work. Plant the strongest roots towards the worst quarter—usually the north or north-west; lean the tree two or three inches in this direction, and tie to a stake without injuring the bark or choking the tree. Leave the topmost roots within an inch of the surface of the soil, and do not dig the heels about the roots, but press steadily; or better still, water the soil, so as to get it of an even density about the roots. The only real necessity at planting is to drive the surplus air out of the soil which would desiccate, and thereby injure, the roots. Water can replace air most effectively. Cut the heads of young trees according to the length of their trunks and the strength of the branches. First cut away those shoots which are too weak to form permanent branches, then select three, or at most four, and cut them according to their respective strength and the angles at which they grow from the trunk. The weakest branch should be left longest (contrary to what is commonly taught, but the world moves, and facts are still stubborn things). The strongest shoot should be pruned lowest, and the others midway between these two; thus the tree will be as here depicted:—



The highest shoot will start first, because it has the most advanced buds, and the greatest attraction for the ascending sap. The lowest and stoutest will start last, and almost certainly throw two branches, which, dividing the strength of the branch between them, will yield shoots of size about equal to the other two, and in the following season choice can be made of that which is of the best size and position.

PLANTING TIME.

Early autumn is the best time to plant deciduous fruit trees in the hot and dry country. Place no fresh or sour manure near where the roots are to stand, but it will always be helpful to work in a barrowful or so of loose sweet surface soil, yard sweepings, or spent manure, with the soil which is to lie about the roots of the young trees. In very dry seasons cover the earth with a litter or manure mulch, so as to keep the soil moist and cause the roots to start, and continue to grow through the early or all the winter, as they will under the best conditions. No mulch should be laid on the surface, where the soil is decidedly wet and cold. There is nothing like a mulch for preventing the caking and hardening of stiff land.

Strips of canvas, paper, bark, or straw should be wrapped round the trunk of every tree from the ground to the branches, to keep the sun and hot wind from burning and hardening the bark. The softer the bark on the trunk, the quicker the sap will flow, and thereby quicken and strengthen the tree. In very hot and exposed positions, the bandages should be kept on for three or four years, or at least until such time as the trees have spread enough to protect their trunks with their own branches. Once or twice a year the bandages should be taken off, cleaned of any insects, the trunks cleaned also, and the bandages replaced. All kinds of trees will be greatly helped by watering during the first two or three years. The most important growths of roots—and on these everything depends—are made in spring and autumn, therefore the soil should be in a free, moist, and well-drained state at these seasons. Whilst all trees should be planted on a more or less raised surface, this surface should be dished so that any water given may not run away from, but soak in about, the roots.

Further, the Farmer's Orchard should be properly fenced, and the necessary labour performed by some one who regards work as something more than a nuisance. Trees are living things, and though they may not reason, they call for the highest powers of reasoning if they are to be thoroughly understood, mastered, and made at all times responsive to human will.

Advantages of Orchards in different Districts.

Victoria has been shown to possess four distinct climatic zones when considered for economic fruits. The essentials to their successful cultivation in the northern and hottest region were also dealt with. It remains to explain what may be done in the south coast region, the hill districts lying more than 1,200 feet above sea level, and the north central districts which do not come under the direct influence of the Southern Ocean, but meet with a good deal of hot dry air from the interior of the continent.

Within these three zones the bulk of our fruits is produced, and the more important farming industries, as well as the most substantial homes, are to be found. In all cases the orchard should be of a size and character in agreement with the general value of the estate and the degree of permanency of the homestead.

Orchards are wanted as protection, as aids to beautifying the surroundings, and as direct sources of profit. But as the country is not all exposed, barren, and unsightly, fruit trees must for the most part be set out with the object of their yielding a direct return, and thereby adding to the value of the farm.

The selling of fruit is scarcely less than a problem to many, and it will never be wise to set about the planting of an orchard in any position until it is clearly seen where the markets are, and how far it will be practicable to reach them with the produce of no more than an acre or two. As a matter of fact, small parcels are of value only when offered in small local markets, and if producers are many and local consumers few, there can be no profit in the venture—that is, apart from its value to the home and farm-yard.

Under the most favorable conditions of soil and climate, the farmer's orchard may be large, and yield a higher average return than any other branch of the estate, since, where animals are kept in large numbers and systematic manuring is practised, the ground and trees yield more and more, and earn an ever-increasing market value for the whole property.

A Direct or Indirect Source of Profit.

The farmer's orchard may, therefore, be a direct or an indirect source of revenue, according to his position, his native capacity, and general plan of operations. Thus we see many fruit-growers turn farmers, and also farmers turn fruit-growers; and, further, some employ a few trees as a hobby, and extend the planting to scores of acres. Everything depends on personal ability to manage trees. Their ways and wants are not so easily understood as are those of cows or pigs. They are of lasting value or are lasting nuisances according as they are understood and cared for, or go unconsidered and uncared for. So, again, one has to say, let the farm orchard be of a size in direct accord with one's knowledge of its wants. Victoria does not really want more fruit trees for its present or immediate population, but more skill in managing the present stock. Skilful orchardists are extremely rare amongst the unsettled population, and if a farmer is not able to discover and direct the necessary work of the orchard, it is doubtful if it will prove a genuine source of profit.

This somewhat lengthy preamble is necessary in order to save those who, seeing others succeed with trees, think that the task is an easy one. Let the farmer who contemplates planting an orchard of any size first read the articles contained in this chapter; then a good book on soil, as are those by Hall, King, and Roberts; also a good standard book on fruit-growing, as Bailey's "Principles," Bunyard's "Fruit Farming," and, for the warmer parts of the State, Wickson's "Californian Fruits." True, these books do not exactly fit in with Australian conditions and wants, but they hold a lot of solid foundation material, and, if well studied in conjunction with local experience and practice, any man equal to managing an orchard will receive sound support from them.

The Value of Local Experience.

But perhaps the safest and surest guide is the methods pursued by a successful local man, for, since all good books are the outcome of actual experience, we shall always find that a man who is succeeding has a great deal to teach others if they will only be modest enough to take it. Busy and successful men have no time to say how it is done, but they do not object to our looking over their fence, and as a glance is as good as a stare to those of the right fibre, the results of every good local effort are plain for all to see.

As the methods of preparing ground, selecting, planting, and protecting of trees have already been dealt with, no more need be said than what is absolutely essential to the three cooler zones of the State.

The Coast Region.

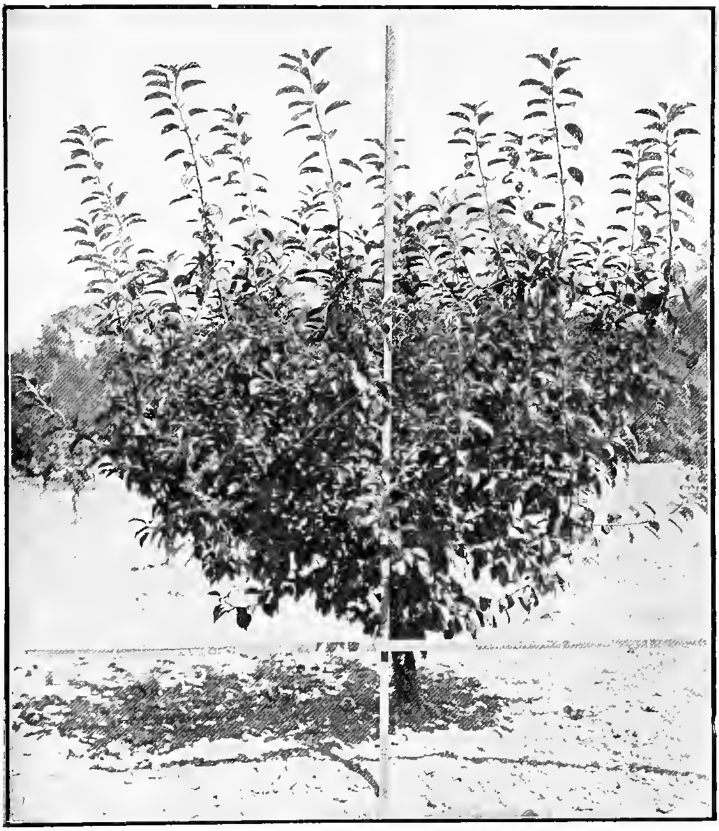
The piece of country lying between the shore and the foothills of the Dividing Range is so vast and varied in quality, position, and climate as to allow of the growth of every kind of fruit common to the whole State; but the farmer who would have an easily-managed and safe little orchard should confine himself to apples, pears, plums, and a few bush fruits. If very near the coast, and a really warm soil and position, a few lemons and oranges may be possible. Peaches and apricots will also thrive where it is warm enough for lemons, but the greatest care is often necessary in selecting both species and varieties in order to insure free growth and regular fruiting. Always supposing a vegetable and flower garden, such fruiting plants as grapes, almonds, oranges, lemons, strawberries, the bush fruits, figs, cherries, and quinces may well be regarded as decorative features of the home, and the true orchard area reserved for the more vigorous tree fruits.

COMPARATIVE VALUE OF DIFFERENT FRUITS.

Of these, the apple is the most valuable; next the pear, and then the plum. Under average conditions, about 100 trees stand to the acre, and in devoting such an area to an orchard one should make up the numbers in this way:—Fifty apples, 30 pears, 20 plums. Should peaches and apricots be known to thrive, and included in the 100, then the list should be as follows:—Fifty apples, 20 pears, 10 plums, 10 peaches, 10 apricots. With a two-acre orchard or extent to accommodate 200 trees, at a given distance, the additions should be in the way of increased quantities of apples and pears, since the above numbers of the other fruits will be ample for the average home. Thus, a two-hundred tree orchard should hold 130 apples, 30 pears, 20 plums, 10 peaches, 10 apricots. Many circumstances may occur to alter the relative figures in these lists, as where soil is too poor for apples very good pears may be grown; hence they may lead in point of numbers. Again, plums are of unequal value in different districts, and, unless they are wanted for preserving in large quantities, or it is known how to convert them into prunes, they should be sparingly grown.

GUIDES TO SELECTING AND FORMING TREES.

As the soil and position vary, so must the strength and build of the tree. For open and trying positions put in none but really vigorous, upright kinds, and for rich soils in protected situations choose rather long-trunked and light wood-forming kinds. Good nurserymen are only too glad to supply what is asked for, providing they are asked in time, and it is often necessary to order trees to be made for a particular situation in order to secure the very best results. Of course, there are ways of strengthening weak trees, and weakening over-strong ones; but for those who do



PRINCE BISMARK, FOUR YEARS OLD, CROPPING TO HEIGHT OF 7 FEET, DIAMETER 8 FEET.

not devote all their time to the study of the orchard it will be at least necessary to start with trees well adapted to meet the conditions.

CONDITIONS FOR PLANTING.

Trees which lose their leaves in autumn may be transplanted at any time between this period and spring; but, in a general way, they are best planted in autumn or early winter—say, May and June. But if soil is at all wet, cold, and sour, the trees should be kept "heeled in" in a specially prepared bed till the worst winter weather is past.

Pears and plums have the hardiest roots when it is an affair of resisting cold and wet; hence they may be set out when they arrive; but apples are more sensitive, and peaches, apricots, and lemons particularly so, and by far the best results are obtained in cold districts when they are nursed through the winter and set out very carefully in September or October.

From Cape Howe to Portland is a far cry when it comes to prescribing an orchard for all the farmers who toil between these places, and no one is more conscious than the writer how many varied plans there must be before all may succeed in making a success of an acre or two of fruit trees.

DRAIN, DEEPEN, ENRICH THE SOIL.

Finally, let every piece of ground put under fruit trees be either drained or ditched, worked to as great a depth as possible, thoroughly cleaned of bad weeds and roots, and dunged and limed as far as it is possible to use these materials. There can then be very little doubt but that trees of some kind or another will thrive well enough to make the venture a successful one.

The Highland Farm Orchard.

Homesteads lying from 1,000 to 1,500 feet elevation are limited to orchard trees which can endure severe frosts, and have the capacity for fruiting in comparatively short summers. Of such are apples, pears, plums, cherries, and all the small fruits.

The main points in planting in high cool country are:—Choosing very airy and well-lighted positions, selecting small wooded types of trees, planting them a good distance apart—from 24 to 36 feet, according to their size and the richness of soil—and keeping the soil firm and comparatively dry in winter. Let us explain these points further. Confined positions make the trees grow coarse, and in some cases they accumulate a great deal of filth in the form of insects, mosses, and other parasites. Well-lighted positions prevent these. Large-framed trees fruit very late in life, and then but irregularly, whereas smaller types mature early and fruit regularly. Open planting secures plenty of air, heat, and light—all very essential in the hills and high ranges. Loose soil encourages roots, and thereby delays the fruiting of the trees; hence, when a tree is well grown it requires to be steadied by means of firm and well-exposed soil. Warm aspects are to be preferred, as also good natural drainage. The banks of streams, boggy or peaty earth, are unsuitable for orchards in high and cool regions, though it is always well to have command of water and plenty of solid material to keep up the fertility of the land.

Many of the points set out in the previous pages of this article need to be studied and acted upon before attempting the formation of a farm orchard in the cool hill districts of the State.

SHAPE AND SIZE OF TREE.

To induce a moderate size when fully grown, the hill orchard tree should have a long trunk, anything between 30 and 50 inches, according to the position and normal vigour of the variety selected. The branches will be light in direct proportion to the length and substance of the trunk. Light depending branches yield a small tree and more regular fruiting than is the case with a tree which has stout upright wood.

PRUNING TO FORM.

Very little pruning is necessary when starting orchards in hilly country. The main work is in the direction of thinning out branches in wrong positions, and in trimming up the trunk to secure a length proportionate to the vigour it displays. Thus one works to keep a weak tree with a short trunk and fairly upright branches, whilst a stout grower must be given a long trunk, not have any of the desired branches cut back, but left full length, that they may weigh out and give the requisite spread and degree of weakness to the head.

CLASS OF FRUIT TO GROW.

Late winter sorts of apples and pears come to fullest perfection in the highest hills, and as these are always of the highest market value, the bulk of the farm orchard should be given over to their cultivation.

The North Central Districts.

The area comprised under this heading is so varied as to call for many different groups of fruits and modes of culture. It is most important to consider first the function of the orchard, as, what purpose will it serve, and will it assist or hinder the general well-being of the farm?

In the driest and most open positions, the orchard will prove the cheapest and surest way of converting a house into a home and of providing more variety, interest, and profit than could the same area if devoted to any other purpose.

WHERE TO LOOK FOR SAFE INFORMATION.

As this region is settled throughout, and every fruit of value has been tested over a considerable number of years, the farmer should have no difficulty in making up a suitable list. What has already been said in reference to selection, planting, and after-care in the north-west and the coastal region will form a basis of operations. There are also the local experience and example of the professional fruit-grower.

Taking this region as a whole, it suffers from rather wide extremes of climate, since the summers are frequently too hot for many fruits, whilst the winters are for others more than a trifle too cold.

FRUITS TO BE SELECTED.

Apples must give place to pears in this zone, as the latter can endure the summer heat and drought where the former often fail. Peaches and apricots have their ideal home in the best-drained and loosest soils of Central Victoria, but these fruits are of little value to the farmer unless he has them in such quantities as will enable him to dry and store, or give them a fixed place in his scheme of farming. Providing that manure or really good deep soil and water are abundant, an acre or two of oranges and lemons may prove a valuable farm orchard; but we must be prepared to feed and protect such trees at all seasons if we would draw a profit from them.

Every permanent country home demands an orchard of some size and type, and it is hoped that this may go some way towards securing better-balanced, more attractive, convenient, and profitable homestead quarters than are generally met with.

GROUPS OF FRUITS SUITABLE FOR VARIOUS REGIONS OF VICTORIA.

Victoria has at least three distinct zones when considered from the commercial fruit grower's point of view. They are:—

I. *Medium Climate.*—This comprises the low and comparatively warm open country running from the south and east coast to the foot of the Dividing Range and ascending to a height of about 500 feet.

II.—*Coldest Climate.*—The various elevated plateaux and slopes of the higher hills which form the Dividing and Gippsland Ranges—country varying between one and three thousand feet in height (above this altitude we are not concerned with fruit-growing).

III. *Hottest and Driest Climate.*—The North-east, Central, and North-western regions passing from Albury to the Goulburn Valley along the Murray to Mildura, and including Horsham, Ararat, Maryborough, and Bendigo.

The following diagram, with list of fruits on the various planes, will afford some idea of the choice to be made when deciding on a new or improving an old orchard.

* *The asterisk denotes the most favorable elevation.*

Pear, Apple, Plum, Cherry, Walnut, Bush Fruits.

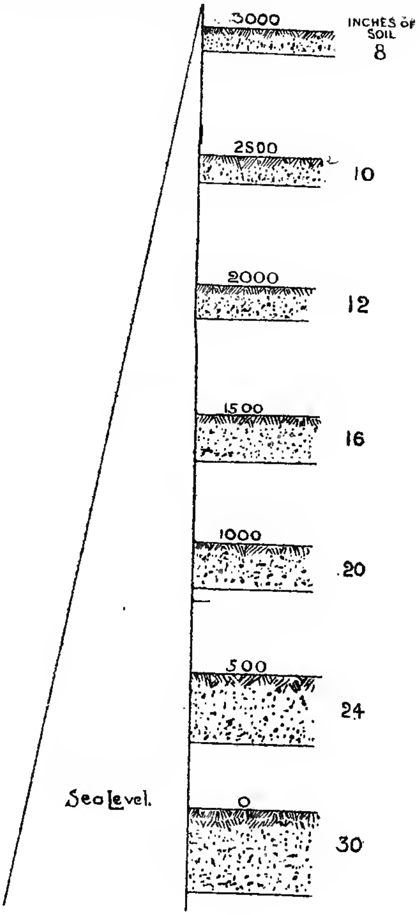
* Pear, Apple, Plum, Cherry, Walnut, Bush Fruits.

* Pear, * Apple, Plum, * Cherry, Walnut, Filbert, Cob-nut, Hazel-nut, * Bush Fruits.

* Pear, * Apple, * Plum, * Cherry, Peach, Apricot, * Walnut, * Filbert, * Cob-nut, * Hazel-nut, Quince, * Bush Fruits.

Pear, * Apple, * Plum, * Cherry, * Peach, * Apricot, Lemon, Orange, Almond, Raisin, Sultana, Currant, Fig, * Quince, Bush Fruits.

Pear, * Peach, * Apricot, * Lemon, * Orange, * Almond, * Raisin, *Currant, * Sultana, * Fig.



It may be observed that the pear is found in every group, no other of our commercial fruits having such a wide range. Hot or cold, stiff or light soils may each and all be used for this fruit, always providing that good drainage is secured. Apples come next, though they fail to thrive in the absolutely hottest and coldest parts, therefore they should not be attempted in the hot and arid north-west nor in the highest settled parts of mountain districts—at least not as a commercial venture.

Fruit trees requiring plenty of sunlight are peaches, apricots, almonds, pears, grapes, orange, and lemon. Trees which thrive best when well protected from strong hot sunlight are apples, cherries, plums, bush fruits, and nuts of all kinds. Studying these two groups may enable one to select according to aspect and general influence of sun and wind. Trees which can put up with stiff, poor, or dry soils are—Pears, plums, grapes, almonds, and apricots. Trees which must have loose deep rich soil are—Lemons, oranges, peaches. Fruiting plants which thrive in peaty and boggy soils are—Quinces, raspberries, figs.

In high hills much more direct light is needed than in low and open country. Small leaved trees are more appropriate to high altitudes than are those of the same species yielding large leaves. Short jointed trees, too, are best for cool and shady positions.

It will be seen in the diagram of the various altitudes that the blocks of soil pass from dark to light as they descend to sea level. This is the reverse of what is commonly found naturally, but in order to properly control trees and insure regular bearing, soil should be of a physical character in agreement with the climatic influences which are brought to bear upon it. Thus, if soil were very deep, loose, and moist at high elevations it would prove too cold to admit of the roots of trees performing the various forms of growth which permit of fruit bearing, and if, on the other hand, heavy and close soils were selected at low levels, they would in the presence of great heat, become too dry, hard, and inert to admit of roots moving regularly within them. Plenty of strong shaly, or coarse, gritty matter is a great advantage in all soils lying above 1,500 feet above sea level. Below the 1,500 feet line the humic quantity is more to be desired, sand or gritty matter being needed only as a medium to prevent caking or clogging at any season. In general practice the high hill soil must be compounded to attract and retain heat, whereas the low valley and plain land must be so made as to attract and retain moisture and dissipate heat.

Taking an ordinary fruit tree irrespective of species or variety, we should, if we displayed a clear grasp of the laws governing all forms of growth, make the length and substance of its trunk and the number and substance of its main branches vary according to the altitude and degree of exposure to which it is to be subjected. Also we should make the above variations according to the soil and general conditions operating in its immediate surroundings. These three trees illustrated are approximately what is wanted in as many positions.

The selection of species, whilst largely governed by the foregoing remarks and diagrams, is also in some measure controlled by the ability and financial resources of the would-be orchardist. Some fruiting trees and plants are much less difficult to manage than others. Further, some can be raised on inexpensive land, whilst others call for the very best. Some come into bearing in two or three years, whilst others not until eight or even ten. Facilities for marketing have to be reckoned with in every venture.

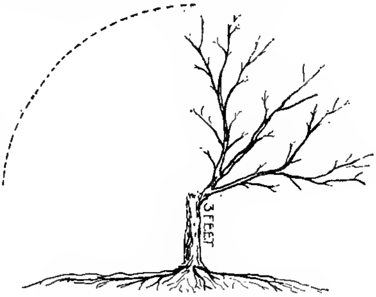


Fig. 1.—Type for high hills with permanent moisture and short mild summer.

Branches long and willowy, far apart and well exposed to sun and wind. Trunk long and thin. Roots shallow (1 foot deep) and far-spreading.

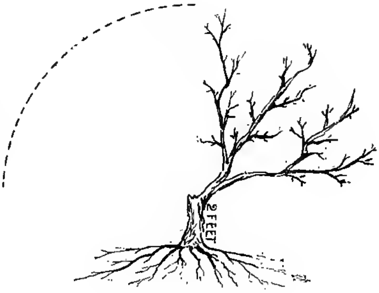


Fig. 2.—Type for moderate hills or good soil in sheltered positions.

Branches medium strength, well spread and somewhat pliant, plenty of space for light and air in motion. Trunk fairly long. Roots medium depth (2 feet), fairly spreading, not overstrong or abundant.

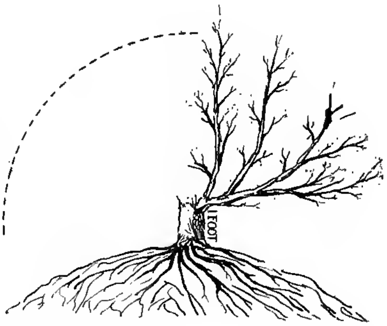


Fig. 3.—Type for low and hot positions, long dry summers.

Branches strong, fairly upright and rigid. Trunk short, thick, and screened by head growth. Roots deep (3 feet), strong and abundant.

Before ordering fruit trees consider all the foregoing and decide as follows:—

Pears.—Of strong upright habit, should have short trunks in low hot and poor soils, the trunk increasing in length and the branches more and more spreading as the hilly regions are selected.

Pears of thin, willowy habit should have short trunks and fairly upright branches in any soil or position, though they must weaken in all parts as they inhabit the cool moist earth and air of high ranges.

Pear trunks should be obtainable at the nurseries of lengths varying between one and three feet.

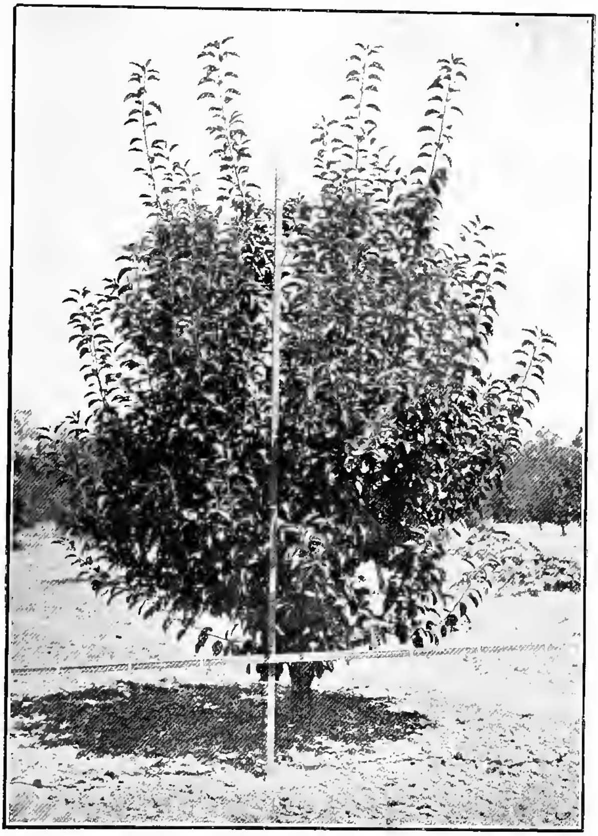
Apples, Cherries, and Plums.—Conform to the same rules as pears.

Peach and apricot should always have short stout trunks; one foot to two feet should be the maximum height.

Lemons and oranges should be regarded as bushes, and, therefore, selected with plenty of foliaged shoots right to the base of the stem.

Almonds, figs, and quinces need short trunks in low hot and poor positions, but trunks up to three or four feet are best in cool altitudes and aspects.

Walnuts call for five or six feet trunks in order to secure early fruiting. It is also necessary to carry them on fairly long trunks where they are planted as breakwinds for orchards, otherwise they are liable to cast too much shadow and prevent the smaller trees from fruiting.



MUNROE'S FAVOURITE, FIVE YEARS OLD, CROPPING TO HEIGHT OF 9 FEET, DIAMETER 8 FEET.

Filbert, cob, and hazel nuts should have clean short trunks in all but the highest hills, where they will be more fruitful if given stems three to four feet in length.

The different sorts of currants and gooseberries need practically no stem in low and exposed positions, but a length varying from six to fifteen inches is wanted in generous hill positions.

Grape vines have permanent wood of different lengths and patterns, according to natural vigour of the different kinds, and the soil, climate, and purpose of the fruit. Only comparatively weak and open trained vines fruit in cool regions, whilst the most robust, compact, and low trained are a necessity in all hot, dry, and exposed quarters.

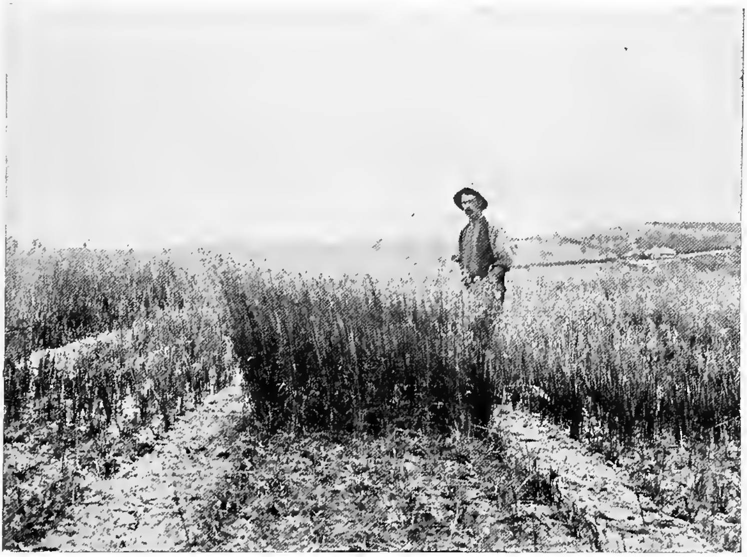
Pears and plums may be one or two years old when selected from a nursery. Apples, cherries, apricots, peaches, should be one year old, and if possible, clean branchless shoots, so that they may, on planting, be cut at a height in accordance with local requirements.

Late Autumn is the best time for planting all kinds of deciduous fruit trees. It is only where the soil is unprepared, wet, cold, and sour that Spring planting is to be preferred.

The main principles controlling the growth and selection of trees have here been set out only in brief, but in such varied ways as to enable any one with a capacitv for orcharding to see where his chance lies, what is to be avoided, and how to make a profitable selection.

CHAPTER VII.

ARTIFICIAL FERTILIZERS.

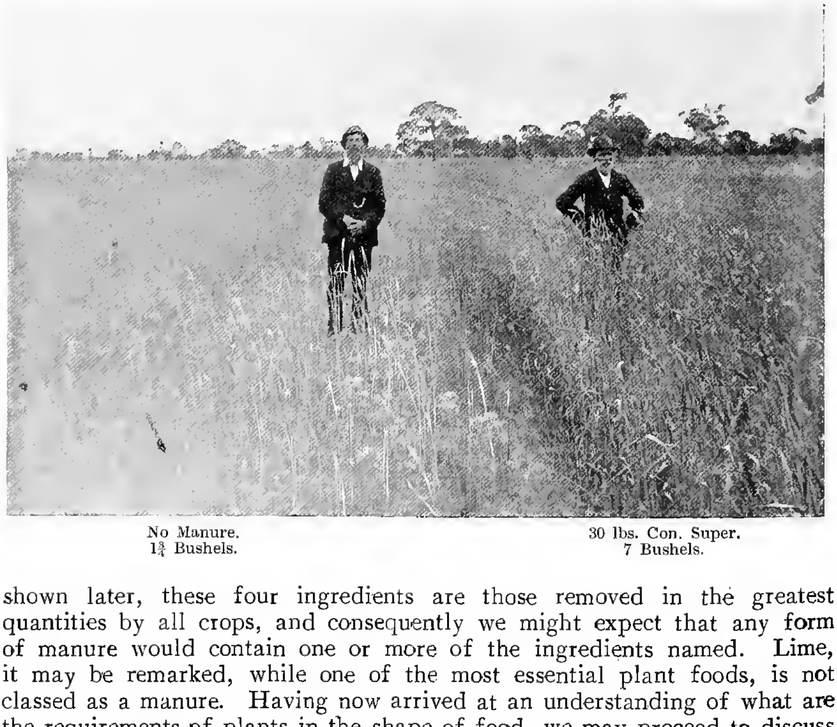


MARKED EFFECT OF PHOSPHATIC MANURING AT BURWOOD.
The adjoining plots are unmanured.

Necessarily any article on farming subjects must treat, first, of the soil and its physical and chemical condition. The term "fertility," I fear, is imperfectly understood by many persons, and I make it a rule in my opening lectures to sketch the conditions that are essential to insure the production of maximum crops. A fertile soil conveys to most persons the idea of ever-green pastures, luxuriant crops, sleek stock, and, in fact, most of the details embodied in the advertising pictures displayed by enterprising vendors of agricultural requisites. Besides, however, the presence of the necessary plant foods, there are other factors which determine fertility, such, for example, as the presence of humus, an abundant supply of moisture, and a natural system of drainage. All these factors working harmoniously constitute fertility, and it may truly be said that complete success is never attained if one or other is absent. An adequate supply of plant food, and humus, conservation and storage of moisture by thorough cultivation, and drainage where needed, are all matters that are quite within the scope of the farmer who intelligently tills his land. It will be seen in subsequent articles what an intimate relation exists between fertilization and cultivation.

What are the Plant Foods?

All plants, no matter of what kind or class, draw upon the soil for a supply of the materials which are necessary to build up their frame, maintain them in health, and provide for the formation of grain, fruit, roots, or flowers. These substances which the plant or crop finds in the soil in greater or lesser quantities are:—Nitrogen, phosphoric acid, potash, lime, iron, magnesia, soda, sulphur, chlorine, &c. For the sake of convenience, they are collectively spoken of as "plant foods." If the question of the fertilization of a soil depended on the supply of all these substances, it is to be feared that the cost of application and labour involved would prohibit much progress being made in the direction of manuring. Nature, however, has been more liberal than may be supposed, and we find that there are, as a rule, only four materials of which there is any cause to fear a diminution in the average soil. These four materials are commonly alluded to as the principal elements of plant food, viz.:—Nitrogen, phosphoric acid, potash, and lime. As will be shown later, these four ingredients are those removed in the greatest quantities by all crops, and consequently we might expect that any form of manure would contain one or more of the ingredients named. Lime, it may be remarked, while one of the most essential plant foods, is not classed as a manure. Having now arrived at an understanding of what are the requirements of plants in the shape of food, we may proceed to discuss in what form these materials may be purchased.



No Manure.
1¾ Bushels.

30 lbs. Con. Super.
7 Bushels.

"Manures" and "Fertilizers."

While we are accustomed, by reason of usage, to call all materials applied to the soil for its improvement by the name of "manures," it may be of advantage to point out that there is a distinction between a "manure" and a "fertilizer." A "manure," properly speaking, is a substance which, besides supplying one or more of the elements of plant food, restores also "humus," or vegetable matter, to the soil, such, for example, as farm manure, roots, and stubble of crops and kindred substances. A "fertilizer," on the other hand, is a material supplying plant food only, and which bears no part in the improvement of the physical condition of the soil, except, it may be, by the promotion of a greater growth of straw and root, which may eventually be returned to the soil.

NITROGEN.

The terms "nitrogen," "phosphoric acid," and "potash" are probably not as familiar to the farmer as the commercial names of the manures which contain those ingredients. It is essential, however, that every user of manures should make himself acquainted with the class or group to which all manures and fertilizers belong; otherwise there is a liability to err in the purchase of a manure that does not contain the ingredient which the soil may require, and which the purchaser wishes to supply. The principal fertilizers on the Melbourne market which contain nitrogen in a predominating degree are:—Nitrate of soda, sulphate of ammonia, dried blood, and nitrate of potash. Each and all of these nitrogenous manures contain nitrogen in varying amounts, and in varying degrees of solubility. The readiness with which nitrogen becomes dissolved by the moisture in the soil influences its effect on a crop to a marked degree. It may also be said to influence its price per unit, as will be shown in the article dealing with the valuation of manures. Nitrogen is the element associated with growth, and the principal function of this ingredient is to assist in building up the framework of the plant, to provide the fleshy portion of fruit, and to store up in the tissues of a crop the necessary protein. This substance when consumed by stock is transformed into lean meat, and eventually reaches the human consumer, in whose body it plays the part of a restorer of the broken-down muscular tissue incidental to the performance of the ordinary functions of life.

Fertilizers which contain nitrogen are the most expensive of all forms, and a high value has rightly been placed on this important element of plant, stock, and human life. Nitrogenous manures have up to the present time played only a minor part in crop production in Victoria. It was demonstrated by the experimental fields throughout the grain-growing areas of the north that up to the present time, at all events, the addition of a nitrogenous manure, either as sulphate of ammonia or dried blood, did not sufficiently stimulate the yield of wheat to pay for its additional cost. We may fairly conclude from this fact that the northern soils are either abundantly supplied with nitrogen, or else that they have other means of obtaining an adequate amount to meet their requirements. How this nitrogen in the grain areas is obtained is a matter that need not concern us at present. In the southern districts of Victoria, however, that is to say, where the rainfall is greater, and the range of crops grown is wider, nitrogen has been most emphatically shown to be necessary in any well-planned scheme of manuring. On hay crops, maize for green fodder, and for grain, potatoes, onions, and other crops it is evident that the more abundant growth of the plant makes greater demands on nitrogen than the average soil is capable of supplying. Hence the necessity of the addition of a nitrogenous manure to the usual phosphatic dressing. It cannot be too strongly urged that the use of nitrogenous fertilizers requires care, or the results may be unsatisfactory to the user. An excessive amount of nitrogen at the disposal of a crop has a tendency to run it up to "top," which can only take place at the expense of the grain or fruit. It must also be carefully borne in mind that excessive growth demands large amounts of moisture, on account of the increase of the evaporating surface. We are all familiar with the manner in which a rankly-grown crop suffers during a hot wind, or a short period of dry weather, especially when grown on shallow cultivated ground. Moreover, there are some nitrogenous manures which, owing to the slowness with which the nitrogen becomes available, exercise a prejudicial effect on crops by keeping the plant growing when it should be maturing, and thus seriously affecting the quality of the product.

As this article is intended to be merely introductory, I trust sufficient has been said to emphasize the necessity of each user of this class of fertilizer making himself familiar with not only the different forms in which it may be purchased, but also with the different manner of its action when applied to a crop. A knowledge of the necessities of each crop indicates that manuring should have a certain definite object, according to the purpose for which a crop is grown.

Before leaving the subject of nitrogen, it is necessary to explain that the form in which plants make use of this ingredient is as a nitrate. As may be seen from the list of fertilizers which supply nitrogen, there are only two—viz., nitrate of soda and nitrate of potash—which contain nitrogen in the nitrate form. All the other forms of nitrogenous manures have to undergo a process of transformation by means of agencies in the soil before the nitrogen they contain is changed from its organic or ammoniacal forms into a nitrate.

PHOSPHORIC ACID.

There is little doubt that the class of fertilizers with which the farmer is most familiar are those belonging to the phosphatic group, viz., superphosphates (concentrated and ordinary), Thomas phosphate, bone-dust, and guano. It has been demonstrated so frequently that the great majority of Victorian soils are deficient in their content of phosphoric acid that it is not at all surprising that there is a multitude of different brands of phosphatic manures on the Victorian market. For grain, hay, fruit, potatoes, maize, grass, and vegetable growing this ingredient is required to such an extent that the idea has grown up in the minds of many farmers that the use of phosphatic manures is the beginning and ending of the whole manurial problem. That such is really not the case is clearly evidenced by the response of crops to other forms of manure which do not contain any phosphoric acid. There is, however, some justification for this implicit faith that is placed in the phosphatic fertilizers, inasmuch as we find that other classes of manures exercise a more beneficial effect when used in combination with the phosphatic manures than when used singly.

In the northern grain-growing areas, the series of experiments launched by Mr. A. N. Pearson, and continued by Dr. Howell some four or five years ago, demonstrated the superiority of superphosphates over Thomas phosphate and bone-dust. In order to properly understand why one class of fertilizer should show such marked superiority over others of the same class, it is necessary to explain in as few words as possible what is the difference in their composition. Phosphoric acid is present in manures in three distinct forms, viz., water soluble, citrate soluble, and insoluble. Superphosphates are the only form of phosphatic fertilizers which supply the phosphoric acid in a form in which it can be dissolved in water. Thomas phosphate, bone-dust, and guano contain no water-soluble phosphoric acid, but are made up of the less soluble forms of citrate-soluble and insoluble phosphoric acid.

The demands of the northern wheat crops are for a manure that will become quickly available, and which will stimulate a rapid growth of the wheat plant, so that it may attain a certain stage before the hot summer weather sets in, and all further growth is arrested. The scanty rainfall of the north is insufficient in normal years to support an abundant vegetation, and farmers living in these areas have come to adopt the superphosphate as the manure *par excellence* for their climatic conditions and limited range of crops. It is a well-known fact, however, that the water-soluble phosphoric acid, which is the distinguishing feature of the superphosphates, when applied to the soil, reverts or changes back to the less soluble form of citrate soluble by combining with lime found in the soil. What, then, is the virtue of the water-soluble phosphoric acid if it only remains in that condition during the earlier stages of plant growth? That it has advantages is apparent from the efforts of the manufacturers of superphosphates to produce an article containing a high percentage of water-soluble phosphoric acid. It is also evident that the farmer places a high value on the content of "water-soluble," and, in point of fact, superphosphates are rated as being of superior or inferior class according as they contain higher or lower percentages of water-soluble phosphoric acid. It may come as a surprise to many readers to know that the water-soluble phosphoric acid is of value principally because of the facility with which

No Manure.
14¾ Bushels.

30 lbs. Con. Super.
25½ Bushels.

it can become distributed when dissolved in soil moisture. Water is nature's great transporting agency, and when the phosphoric acid becomes dissolved it is carried to every part of the soil and brought into intimate contact with the soil particles. Were it not for this faculty, it is to be feared that only those plants in the immediate vicinity of the spot where the fertilizer had lodged would benefit much from its services. Furthermore, the roots of plants would not be encouraged to permeate every nook and cranny of the soil in search of food and moisture. It is, perhaps, superfluous to add that a plant having an elaborate root system is better fitted to sustain the lengthy periods of dry weather which occur with such regularity in most farming districts, than one with a restricted root area. In superphosphates the proportion of citrate soluble and insoluble phosphoric acid is small—so small, in fact, that in many well-made superphosphates the percentage of the former rarely exceeds 2 or 3 per cent., and the latter 1 per cent. In Thomas phosphate and bone-dust, however, we find that out of a total content of phosphoric acid of, say, 15 or 16 per cent., 11 to 12 per cent. of it is in the form of citrate soluble, and 4 to 5 per cent. insoluble. As a consequence, these forms of phosphatic manures have come to be more used in districts having a fair average rainfall, and on crops to which they are suited by reason of their slower availability. Guano, it may be said, is not so much used nowadays as superphosphates, although it is not infrequently worked up with acids and sold as phosphatic guano, &c.

The function of the phosphoric is to improve the quality of the product, and it is usually found in the largest amounts in the grain and seeds of cultivated plants. I might draw the attention of the reader to the steady withdrawal of large amounts of phosphoric acid from the grain districts in the export of millions of bushels of wheat and oats. Is it to be wondered then, that the manures which contain this ingredient should become the ones most in demand for the cereal-growing districts?

It is not too much to say there is still a wide field for development in the use of phosphatic manures. We read from time to time that outbreaks of cripples have occurred in certain localities, and that the absence of bone-making material in the soil is responsible for a stunted, unhealthy growth of stock. This evil state of affairs might be bettered considerably by the application of phosphatic manures to grass land, and, with a hardier and more vigorous growth of grass, would follow the disappearance of those diseases which are directly traceable to an absence of phosphates.

It may be of service to many farmers to know that superphosphates should never be mixed with lime or wood ashes (which contain lime) in order to facilitate their passage from the drill. Lime when used in such a way would at once combine with the water-soluble phosphoric acid in the superphosphate, and turn it back to the less soluble citrate-soluble form before it would have the opportunity of becoming distributed through the agency of the soil moisture. Gypsum may be used with safety, or, what is better still, loam or sand, if a fertilizer is found to be clogging the drill.

POTASH.

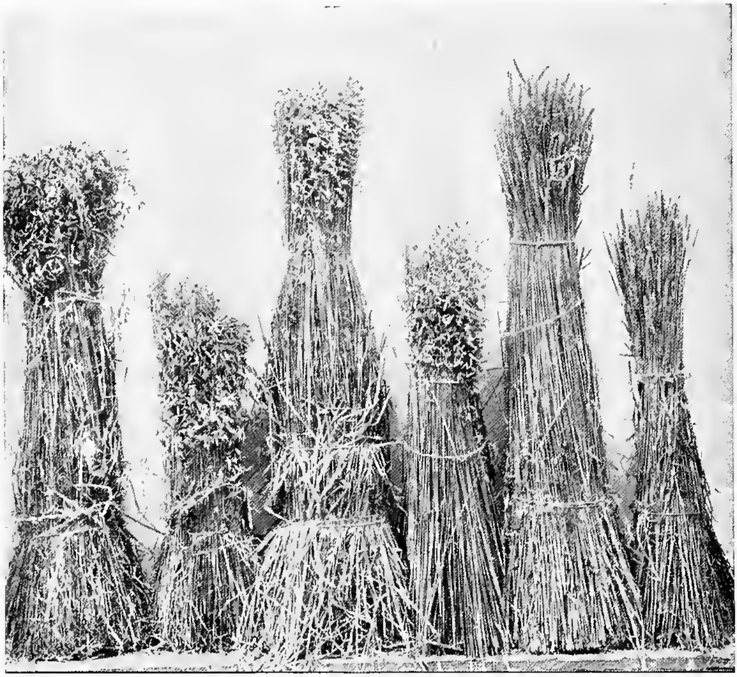
Potash manures are perhaps the least used of all forms by the average farmer, and, as a consequence, there is little or no knowledge of its commercial forms and action in the soil. It by no means follows that because it is infrequently used that it has any inferior value to the other plant foods. On the other hand, potassic manures should occupy a dominating influence in the fertilization of soil for the growth of such crops as legumes, fruit, and root crops. It is advised, however, that fertilizers containing potash should always be used in conjunction with other manures, their best effects not being so apparent when used singly. It is not so many years ago that practically the only source of potash was wood ashes; since, however, the discovery of enormous deposits of potash at Stassfurt, in Germany, the world's supply is now drawn from that source. The commercial forms in which potash is sold are:—Muriate of potash, or potash chloride, sulphate of potash, and kainit, all of which are imported from Germany. There is a potassic manure sold under the name of Australian potash, which comes from the burning of refuse molasses from sugar refineries, the potash contained therein existing principally as carbonate and chloride of potash.

No Manure.
13 1-5th Bushels.

20 lbs. Con. Super.
21¼ Bushels.

The functions of the potash may in a general manner be described as influencing the quality of agricultural products rather than the quantity. For such crops as fruit, potash affects the quality, flavour, and aroma, increases the percentage of starch in potatoes, improves the burning qualities of tobacco leaf, and promotes the formation of sugar in sugar-cane and sugar-beet. Maize, lucerne, peas, and beans also respond to the action of potassic manures.

As with nitrogenous fertilizers, fertilizers containing potash must be used with a certain amount of caution and intelligence; otherwise the results may not be satisfactory. For example, some forms of potassic fertilizers are said to exercise a deleterious effect when applied to certain crops. Potash chloride may give rise to "stagginess" in potatoes, although this is a debatable point; may lower the burning qualities of tobacco leaf, and may prejudice the formation of sugar in the beet. For these crops named it would be wiser to use the sulphate of potash. Kainit, which, by the way, is a form of potassic fertilizer perhaps more frequently made use of than the more costly chloride and sulphate forms, contains, in addition to a limited amount of potash, chloride of sodium, or common salt, and magnesia. It may not be the desire of some users of kainit to add salt and magnesia to their soils, in which case other forms of potash should be used in preference. It is claimed that one virtue of kainit is its hygroscopic power, or property of absorbing moisture from the air, which renders it of value on dry sandy soils. As an exterminator of grubs and similar pests which infest some soils, it has a certain value better appreciated in Europe than in Australia. Compared, however, with muriate and sulphate of potash, kainit is, relatively speaking, the most costly form in which a definite amount of potash can be bought. It would be more serviceable and more economical to use approximately one-fourth the amount of the more expensive forms.



EFFECT OF PHOSPHATIC MANURING AT COLAC.

The small sheaves are from unmanured plots.

In the northern grain areas, potash, judging from the results of experimental fields, does not, up to the present time, justify its inclusion in the manurial dressing. Wheat, above all crops, can thrive with relatively small amounts of potash, and, furthermore, the common practice of burning stubble gives back to the soil some of the potash removed by the crop.

Other Considerations.

It would be an omission in any discussion on artificial fertilizers if some mention were not made as to the "mechanical condition" of these substances. The user of fertilizers demands that, besides an article of good quality, it shall be in such a condition of fineness that there shall be no hindrance to its free flow from the drill. An excessive percentage of moisture in a fertilizer lowers its apparent quality, and adds unduly to its weight; hence the importance, from a purchaser's point of view, of taking note of the moisture content of all fertilizers offered for sale. In the purchase of bone-dust or bone-meal, there is even greater necessity than with mineral manures that the "mechanical condition," or percentage of "fine" and "coarse" material should be stated. The recently passed Artificial Manures Act requires that the percentage of "fine" and "coarse" material shall be stated on the accompanying certificate. "Fine" material, it may be added, is that portion that passes through a sieve having fifty meshes to the linear inch; and "coarse" is the portion which does not pass through a sieve of the above mesh. We may state that there is a material difference in the cash value of the plant foods contained in bone-dust, amounting to 1s. 6d. for each per cent. of nitrogen in favour of the "fine" portion, and 1s. 8d. for each per cent. of phosphoric acid of the same designation.

COMMERCIAL FERTILIZERS.

So universal during the last few years has the use of artificial fertilizers become that there remains only a small percentage of farmers who are unacquainted with the benefits to be derived from the use of these substances. The comprehensive series of experiments conducted by this Department in almost every district in the State, and on nearly every class of farm crops, in the orchard and in the market garden, has done much to popularize the use of these artificial aids to fertility. The duty of the Department, however, by no means ends with the mere demonstration that certain crops respond to the action of certain classes of fertilizers. That there is a difference in the action of two fertilizers belonging to the same group is well known, and it is just what is this difference of action that is the weak spot in the purchase of these substances by many farmers.

One of the provisions of the Amended Fertilizers Act, passed at the latter end of 1904, requires that the certificate which accompanies each parcel of manure shall indicate, not only what plant foods are present, but in what form those plant foods occur. The raw materials from which manures and fertilizers are made contain the plant foods in different forms; for example, nitrogen is contained in the nitrate form in nitrate of soda and nitrate of potash, in the ammoniacal form in sulphate of ammonia, and in the organic form in dried blood, bonedust, bones, and digester refuse (hashmagandy), and manures of a similar class.

It is well known that plants use the bulk of their nitrogen in the nitrate form, hence the more rapid action of those fertilizers which contain the nitrogen as nitrates. The ammoniacal nitrogen in sulphate of ammonia has first to be transformed by soil agencies into a nitrate before becoming available. This accounts for its somewhat slower action. The nitrogen in organic forms, such as dried blood, bonedust, &c., farm manure, refuse of crops, &c., has first of all to undergo the process of decomposition, during which the nitrogen is transformed in compounds of ammonia, and eventually into nitrates.

It is not difficult to understand that the fewer transformations there are necessary the more rapidly a plant will avail itself of the food.

Manures on the Victorian Market during 1905.

There are in Victoria nearly 50 manufacturers and vendors of artificial fertilizers. Some of these manufacture several classes of fertilizers, and put them on the market singly, or in combination, under various trade names. Others simply represent foreign firms, and import the manufactured article. As the purpose of this article is not to draw comparisons between the fertilizer vended by one firm with that of another, it is sufficient to say that each purchaser should satisfy himself before buying that the money value of the article corresponds to the price asked for it.

A list of all fertilizers sold on the Victorian market was published in the *Journal* for July, 1905, and it is from this list that the following analyses and money values are taken.

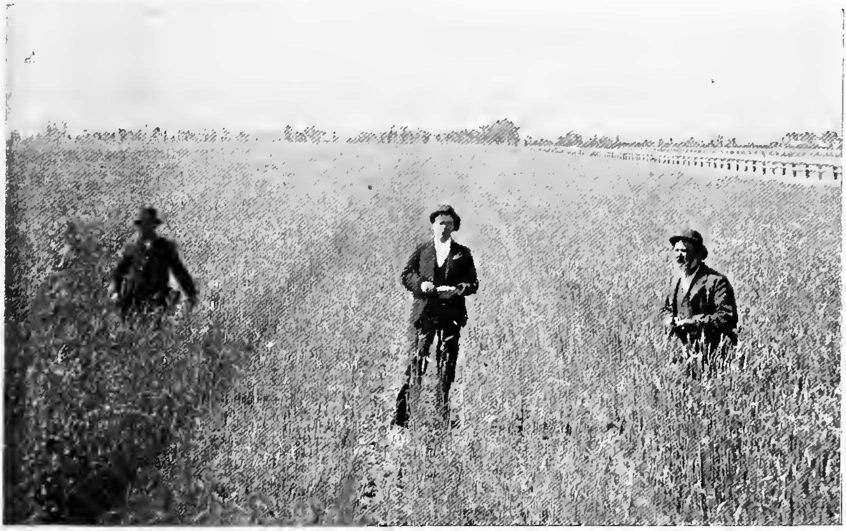
MAINLY NITROGENOUS.

Under this heading come nitrate of soda and sulphate of ammonia. The former, the source of which is the far off region of Chili, contains an average of 15.5 per cent. of nitrogen, and is sold for £12 per ton. The latter, which is a by-product in the purification of coal gas, and contains from 20 to 21 per cent. of nitrogen, sells from £15 to £15 10s. per ton. A sulphate of ammonia having a lower percentage of nitrogen than 20 per cent. should sell at a correspondingly lower price. Both these forms of nitrogen are expensive, but it should be remembered that their effect is rapid, and much smaller amounts per acre are necessary than in the case of the less soluble organic forms.

MAINLY PHOSPHORIC.—READILY SOLUBLE.

This group includes all superphosphates, both ordinary and concentrated, superphosphate and bonedust mixed, and nitro-superphosphates. In all these fertilizers some of the phosphoric acid is in a "water-soluble" form, although it should be pointed out that in the case of a mixed superphosphate and bonedust the proportion of "water-soluble" to the more slowly available forms is much less than in ordinary superphosphates. There are nearly 30 different brands of superphosphate, the quality ranging from 13.68 per cent. to 23.24 per cent. total phosphoric acid. The factor which determines the quality of a superphosphate is its content of "water-soluble" phosphoric acid, hence the necessity of knowing what proportion of the total phosphoric acid present can be dissolved in soil moisture. A scrutiny of the list referred to will show that there is a wide divergence.

It was pointed out in the introductory part of this chapter that the chief advantage of a superphosphate containing a high percentage of "water-soluble" phosphoric acid was the facility with which it could be thoroughly incorporated with the soil. Plants, however, are not absolutely dependent for their food supply on those ingredients which are soluble in water, but are capable, by means of the slightly acid juices contained in their roots and root hairs, of making use of the less soluble forms. It is difficult, if not impossible, to say just how long the phosphoric acid supplied to the soil by a superphosphate remains in the "water-soluble" form. Having become distributed, it unites with lime, as well as iron and alumina in the soil, and reverts to the citrate-soluble form, in which it remains for a time until attacked and made use of by the acid secretions in the roots of growing crops. Soils abundantly supplied with lime would cause a reversion from the "water-soluble" to the citrate-soluble form quicker than where such is not the case. There is little or no danger of phosphatic manures being washed out of the ground by heavy rains. The question is frequently asked by farmers whether the benefit of the superphosphates lasts over from one crop to another. There is a certain effect observable on the second crop, which is spoken of as its "residual" effect, but it must not be expected that a highly-soluble fertilizer like superphosphate will give more than a minor effect in a second year.



50 lbs. Ord. Super.
20¾ Bushels.

No Manure.
5 3-5ths Bushels.

30 lbs. Con. Super.
15 3-5ths Bushels.

Nitro-superphosphates are fertilizers much in favour among farmers in some localities, and the use of them is frequently justified by the requirements of the soil; but where phosphatic fertilizers only are required, the nitro-superphosphates must be considered as the dearest form in which to purchase phosphoric acid. The small amount of nitrogen present, about 1½ per cent. on the average, means the expenditure of 14s. 3d. per ton on unnecessary material. Where, on the other hand, the soil requires a little nitrogen, the nitro-superphosphate renders good service.

Phosphoric Acid predominating, but containing Nitrogen also.—Phosphoric Acid, difficultly Soluble.

Included in this group are bonedust, bonemeal, bones, and digester refuse, nitro-guano, orchard, onion, grass, leguminous, horticultural, special potato and other mixed manures. The mixed manures for the orchard, grass, horticultural, &c., contain phosphoric acid in a "water-soluble" form, in proportionately large amounts; but the bonedusts, bonemeals, digester refuse, &c., only contain phosphoric acid in an insoluble form. Before using this class of manures caution is required, especially when it is intended to use them on quick-growing crops. The average percentage of nitrogen in the bonedusts on the market is between 3 and 4 per cent., and the average total amount of phosphoric acid between 20 and 25 per cent.

For such manures as bonedusts and bonemeals, however, the Act requires that the "mechanical condition," or percentage of fine and coarse material, shall also be stated. The average mechanical condition of Victorian bonedusts is, approximately, fine material, 30 per cent.; coarse, 70 per cent. This can only be considered moderately good from the point of view of the availability of the plant foods. The more nearly the fine and coarse material each approach 50 per cent., the quicker the manure will take effect on the crops to which it is applied.

MAINLY PHOSPHORIC.—MODERATELY SOLUBLE.

Another well-known phosphatic fertilizer, viz., Thomas' phosphate, comes within the above classification. Thomas' phosphate is a by-product obtained from a certain process (Thomas-Gilchrist) of steel-making. All users of this fertilizer are familiar with its heavy weight, under a small bulk. The quality of this article on the Victorian market has deteriorated during the last few years. The range of four samples at present being 15.60 per cent. to 19.06 per cent., with an average of 16.85 per cent. total phosphoric acid. The phosphoric acid is present chiefly in the citrate-soluble form, with a small percentage of insoluble.

On some soils, both in the north and south, Thomas' phosphate has shown results very fairly comparable with those produced by the more readily available superphosphate. Land that is of a clayey or "heavy" nature, or which, through lack of natural or artificial drainage, is "cold" and "sour," responds to a dressing of Thomas' phosphate. There is little doubt this is due to the relatively large proportion of free lime present, which exercises a beneficial action on clay soils, and neutralizes the acid conditions of poorly-drained land.

MAINLY PHOSPHORIC.—DIFFICULTLY SOLUBLE.

There is yet another classification of fertilizers and manures containing phosphoric acid., viz., those in which the bulk of this ingredient is in an insoluble state such, for example, as Tricalcic phosphate, calcium phosphate, and guano. These materials have a total content of phosphoric acid, ranging from 8 to 30 per cent., of which 60 to 80 per cent. is in the insoluble form. They are little used by farmers, and, with the exception of the guano, which contains a trace of nitrogen, need hardly be considered.

MAINLY POTASSIC.

Under this heading are included potash sulphate, potash chloride (muriate), kainit, and nitrate of potash. The first three named are all imported from Germany, from whence is derived the world's supply of potash.

Potash sulphate contains from 48 to 51 per cent. of potash; potash chloride from 52 to 56 per cent.; kainit from 12 to 14 per cent.; and nitrate of potash 46 per cent., in addition to 13.4 per cent. of nitrogen. Kainit is, therefore, the poorest from the view of a supplier of potash, and it has the added disadvantage of containing common salt and magnesia, substances which it may not be advisable to introduce into some soils.

Nitrate of potash is infrequently used in Victoria, principally on account of its high price. Mixed with a phosphatic fertilizer it forms a complete manurial dressing, eminently suited for fruit trees, roots, and other crops requiring potash in abundance.

Before leaving the potassic group, it is not out of place to say a few words in favour of wood ashes as a medium of potash supply. Ashes contain the mineral portion of the wood from which it has been obtained, consisting of lime, phosphoric acid, and potash. The phosphoric acid and potash in wood ashes are in a very soluble state, and are readily assimilated by most plants. The ash of Australian timbers varies considerably in its content of phosphoric acid and potash. Generally speaking, the hardwoods are richer than the more open-grained varieties. The ash of the Australian "grass-tree" contains appreciable amounts of the two ingredients named. Grape vines also produce an ash containing relatively high amounts of phosphoric acid and potash. Ashes should be applied to the soil in an unleached condition, that is to say, they should not be exposed to rain, or the most soluble and valuable ingredients contained may be washed out.

No Manure.
13½ Bushels.

50 lbs. Ord. Super.
18 Bushels.

Hints on Mixing Artificial Fertilizers.

Besides a general understanding of the functions of manures, and a knowledge of their differences in action, there is still a necessity for some information as to their handling before sowing.

Nitrate of soda should never be sown at the same time as the seed is sown. On account of its immediate solubility, and the fact that it already is in a form in which plants use it, the nitrogen is liable to quickly leach out of the ground, and be removed in drainage waters. Under these circumstances, nitrate of soda has come to be generally used as a spring top-dressing, at which time there is an abundant root growth, and the nitrogen is made use of rapidly by the growing crop.

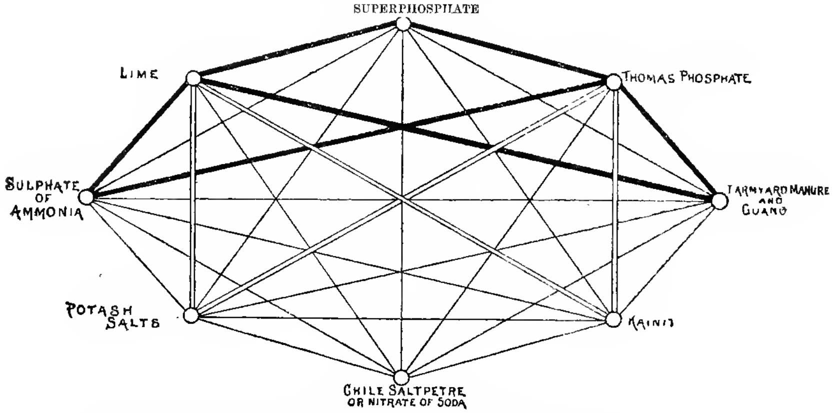
Sulphate of ammonia should never be mixed with lime or any manure containing lime, such as Thomas' phosphate or wood ashes. Lime drives off the ammonia, and the quality of the fertilizer is thereby lowered by ignorant handling.

Superphosphates should not have lime in any form added to them for any purpose, nor should superphosphates and Thomas' phosphate be mixed, on account of the lime present in the latter. Bonedust and superphosphate may be mixed without danger. Gypsum may be added to most fertilizers without in any way lessening their action, in fact, the addition of gypsum may add materially to the productive power of many fertilizers.

Slowly soluble manures are best sown some time previous to the crop. Lime should always be sown in the early winter, and be harrowed in rather than ploughed in.

Never sow either seed or phosphatic fertilizers within at least a month of sowing lime.

A highly serviceable and practical manner of illustrating which fertilizers should not be mixed together is set out in the accompanying illustration, prepared by Dr. Geekens, of Alzey, Germany:—



Substances connected by thick line must not be mixed.
Substances connected by double line must only be mixed immediately before use.
Substances connected by single thin line may be mixed at any time.

Artificial Fertilizers in comparison with Farmyard Manure.

It not infrequently happens that a farmer is desirous of restoring the deficiencies of plant food in his soil, either wholly or in part, by means of a dressing of farm manure. At the same time, he wishes to know what dressing he should give to supply, approximately, the same amount of the necessary ingredients as could be restored by a combined fertilizer. Farmyard manure, being an article of extremely variable quality, can only, in a comparison of this kind, be calculated on its average content of the fertilizing ingredients—nitrogen, phosphoric acid, and potash.

If we assume that 1 ton of average farm manure contains nitrogen, 8 lbs.; phosphoric acid, 6 lbs.; and potash, 6 lbs.; and a 2½ cwt. dressing of a combined manure, made up of such familiar substances as 2 cwt. of bonedust; and ½ cwt. of kainit, contains, approximately:—

		lbs.
2 cwt. (average) bonedust	nitrogen	7.8
	phosphoric acid	50.4
½ cwt. (average) kainit	potash	6.5

we may roughly calculate that 1 ton of farmyard manure supplies an equivalent amount of nitrogen and potash to the fertilizer mixture, but over 8 tons would be required to supply the same amount of phosphoric acid as in the combined artificial mixture.

As phosphoric acid is the chief plant food deficient in most Victorian soils, it is not difficult to understand that farm manure is an unsuitable substitute for a mineral phosphate.

Summary.

This description of the artificial fertilizers on the Victorian market aims only at the elucidation of the main facts in connexion with these substances, and is in no way intended to recommend the article sold by any particular firm, nor, on the other hand, does it attempt to decry the value of any fertilizer now being vended.

50 lbs. Ord Super.
16 4-5ths Bushels.

No Manure.
5 3-5ths Bushels.

30 lbs. Con. Super.
16 1-5th Bushels.

The only advice that can be given to the purchasers of fertilizers is—"See that the article you buy is accompanied by a certificate setting out the ingredients contained, and the form in which they are present." With a general understanding of the function of each ingredient, and its action in the soil under certain conditions, there should accrue much better results from fertilizers than is frequently the case at present. I would also urge that each purchaser of more than one class of fertilizer should familiarize himself with the general appearance, colour, &c., of all samples on the market. In the purchase of bonedusts, the smell should not be relied upon to indicate the quality. The day has gone by when bonedusts are bought on the offensiveness of their smell alone.

Information relative to the use and value of manures may be obtained at any time on application to this Department.

HOW TO VALUE ARTIFICIAL MANURES.

History of the Legislation.

The necessity for legislation to regulate the sale of artificial manures and to prevent refuse materials from masquerading under high-sounding titles, without a proper explanation of the sources from which they are derived, is no new matter in Victoria. As far back as 1897, the Victorian Parliament passed an Act, known as the "Artificial Manures Act," the object of which was to compel all manufacturers and vendors of manures to state, by means of a printed guarantee, what percentages of nitrogen, phosphoric acid, and potash, were present; and also in what form they occurred. To enable this to be done, the Act provided that a certificate should accompany every parcel of manure over the amount of ½ cwt. The certificate was intended to be, so to speak, the receipt of the purchase of so much plant food in various forms. Penalties were provided for under the Act for the prosecution of vendors who, knowingly or unknowingly, sold manures not up to the standard (after being allowed a liberal margin) quoted by the certificate. If a purchaser were dissatisfied with the article purchased by him, he was entitled, within a certain time, to take three equal samples; hand one sealed sample to the vendor (or his agent). retain one, and forward the third sample to the Agricultural Chemist or to any qualified analytical chemist, accompanied by the necessary fee. If the analysis of the manure showed it to contain less plant foods (after deducting the fixed margin) than stated on the certificate, the person purchasing such manure was entitled to sue on a breach of warranty.

Previous to some four or five years ago, the use of artificial fertilizers was by no means so universal as it is to-day, and the majority of farmers either neglected to procure the necessary certificates (perhaps being unaware of the advantages of doing so), or else were unacquainted with the methods used to estimate the "real value" of the article therefrom. It is not difficult to understand that, owing to the apathy of many purchasers of manures, few prosecutions were undertaken under the Act. As the use of fertilizers became more general, the increased demand created the necessity for more protection to the purchaser, which culminated in the repeal of the 1897 Act and the passing of the present Artificial Manures Act, in November, 1904.

Under the new Act, as under the old one, stringent provision is made for the delivery to the purchaser of a certificate, setting forth the name and business place of the vendor, the trade mark, quantity sold, and the percentages of nitrogen, phosphoric acid, and potash; and also the forms in which they respectively occur. Whether the fertilizer is paid for at the time of sale on not, the certificate must be delivered at the time of sale, or before delivery of the whole or any part. The penalty of non-compliance with this clause of the Act is a fine not exceeding £5 (on conviction) for the first offence, and not exceeding £20 for any subsequent offence.

Any purchaser wishing to take proceedings shall submit a sample of the manure purchased within fourteen days after the delivery of the whole or part, and shall give written notice to the vendor, or his agent, of his intention to have such manure analyzed by an official analyst, and shall invite the vendor or agent, at any time within fourteen days, to be present at the taking of the sample. If the vendor or agent, within ten days, fails to be present, the purchaser may take the sample himself, and, not later than one month, may forward one part, in a sealed glass-jar, to the vendor or agent, retain a similar portion himself, and forward a similar amount to an official analyst. The notice may be sent by registered letter to the vendor, or to the usual place of business of the agent. A severe penalty is provided to meet any attempts at fraudulent tampering with any sample. Samples sent to an official analyst living more than 2 miles from the residence of a person requiring the analysis should be sent by post as a registered parcel.

Clause 16 of the Manures Act provides that a "margin" shall be allowed to the manufacturer of ½ per cent. of the whole amount of nitrogen present, 1 per cent. of phosphoric acid, and ½ per cent. of potash, in manures containing less than 10 per cent. of nitrogen or potash, and less than 15 per cent. of phosphoric acid. In nitrogenous manures containing more than 10 per cent. of nitrogen, a margin of 5 per cent. of the whole amount is allowed; in phosphatic manures represented to contain more than 15 per cent. of phosphorc acid a margin of 7 per cent. of the total amount is allowed; and in potassic manures certified to contain more than 15 per cent of potash, a margin of 10 per cent. of the whole is allowed. All manures imported into Victoria must comply with the analyses required for locally-manufactured manures.

The Agricultural Chemist, or his deputy, or any police officer, is empowered at any time to require the purchaser of any manure to state the name of the firm from which the article has been purchased, the price, and may require the purchaser to produce for inspection the certificate referring to such manure. Penalties are provided for any non-compliance, or for any obstruction in the execution of such duty. Any vendor or agent may be proceeded against for a breach of warranty if the analysis of the manure sold by him is proved not to be up to the standard (after allowing the "margin") stated by the certificate. Any purchaser of manure has the right to take action for civil damages in the event of the manure being proved not to be within the required standard.

Prosecutions may be instituted, under the Act, by the Agricultural Chemist, his deputy, a police officer, or any person aggrieved. The cost of prosecution shall be borne by the party losing the suit. The burden of proof that a certificate was given to the purchaser at the time of sale shall lie on the defendant.

The Calculation of Unit Values.

In order to establish standards for the estimation of the values of all manures on the Victorian market, the Manures Act of 1904 provided that every manufacturer, vendor of, and dealer in manures shall once a year, not later than the 16th of January, forward to the Agricultural Chemist samples of all manures he will sell during the ensuing twelve months, and which are not likely to vary in quality, together with the selling price. These samples are classified and analyzed, and the average quality of all manures belonging to the same class estimated. The average selling price is divided by the average percentage of the particular plant food present, and the quotient forms the unit value, or value of 1 per cent. in a ton of manure of such ingredient for the ensuing twelve months. Under the

Amended Manures Act, passed during the present session of Parliament, the time for sending in samples by manufacturers is altered to the months of October and November. All samples sent in by manufacturers are accompanied by a statutory declaration that the sample fairly represents the quality and the price for the ensuing year.

The Act further provides that the list of all manures on the Victorian market, together with their analyses, selling price, and "real value" (as calculated from the unit values) shall be published in the *Government Gazette.* Under the Amended Act, the analyses of all samples taken in the country by the Chemist, or his deputy, or other officials, are also published in the *Government Gazette,* as a guarantee that the manures vended actually do agree with the samples sent to the Chemist by the manufacturers or vendors.

20 lbs. Con. Super.
20 3-5ths Bushels.

No Manure.
14½ Bushels.

10 lbs. Con. Super.
20 Bushels.

The Unit Values for 1905.

			s.	d.
1 per cent. of Nitrogen in the form of	Nitrate of Soda	is worth	15	6
1 ,, ,, ,,	Nitrate of Potash			
1 ,, ,, ,,	Sulphate of Ammonia	,,	14	4
1 ,, ,, ,,	Blood Manure	,,	11	0
1 ,, ,, ,,	Fine Bonedust	,,	11	0
1 ,, ,, ,,	Coarse ,,	,,	9	6

In the mixed manures, such as Phosphate mixture, Bones and Digester Refuse; Blood Bone and Hashmagandy; Dried Blood and Organic Matter; Bone and Wood Ashes; Superphosphate and Gypsum; Bonedust and Gypsum; Potato Manure; Bone, &c., Manure—1 per cent. of Nitrogen is valued at 9s. 6d.

If an invoice certificate does not state whether the Nitrogen in the Manure is in the form of Nitrate, or Sulphate, or Blood, or Bones, it should be assumed to have the value of Bone Nitrogen.

In the complete manures, such as Orchard and Onion, Grass and Horticultural Manures, where the Nitrogen is contained in the Nitrate form, the value of 1 per cent. is 15s. 6d.

			s.	d.
1 per cent. of Water Soluble Phosphoric Acid		is worth	5	3
1 per cent. of Citrate Soluble Phosphoric Acid ..	Thomas Phosphates Nitro Superphosphates Ordinary Superphosphates Guanos ..	,,	4	8
1 per cent. of Insoluble Phosphoric Acid ..	Thomas Phosphates Nitro Superphosphates Guanos ..	,,	3	0
1 per cent. of Insoluble Phosphoric Acid in Ordinary Superphosphates		,,	1	0
In a Bonedust—				
1 per cent. of Phosphoric Acid in Fine Bone		,,	4	8
1 ,, ,, ,, Coarse Bone		,,	3	0
1 per cent. of Potash		,,	5	6

20 lbs. Con. Super.
20 3-5ths Bushels.

No Manure.
10½ Bushels.

10 lbs. Con. Super.
20 Bushels.

"Real Value" and "Agricultural Value."

The term "real value" must not be confused with the "agricultural value" of a manure. The former represents the value of the manure, according to the average price charged by all vendors, for the various ingredients of plant food. The "agricultural value" of a manure is a matter subject to so many influences, such as the weather, crop upon which used, time of using, and, above all, the quality of the soil to which the manure is applied, that no fixed value can be placed on any ingredient as a factor in the production of crops.

Calculation of Commercial Value from Certificate.

In order to ascertain the value of any fertilizing material containing one or more ingredients of plant food, it is indispensable to have the certificate showing the percentages of nitrogen, phosphoric acid, and potash guaranteed to be present, and also indicating the form in which the ingredients occur. For example, a certificate which merely stated that there was present in a mixture:—nitrogen, 3 per cent.; phosphoric acid, 15 per cent.; potash, 12 per cent., would be of little service to the purchaser, because he would not know if the nitrogen was worth 15s. 6d. or 9s. 6d. for each per cent. Similarly, the phosphoric acid might be worth 5s. 3d. or 3s. The potash is worth 5s. 6d. for 1 per cent. in any form, but all forms are not equally soluble, nor are they all equally suited to the needs of quick or slow-growing crops.

Reference to the list of unit values will show that the form in which nitrogen occurs is more or less valuable, according as it is nitrate, ammonia, or organic nitrogen. Attention may be drawn to the fact that the nitrogen in fine bonedust is worth 1s. 6d. per cent. more than the same nitrogen in coarse bonedust. Why is this so? The nitrogen in one is the same as in the other. The difference, therefore, lies in the more rapid availability of the nitrogen in the fine bonedust. Coarse lumps are not only difficult to distribute through a drill, but remain in the soil a considerable time before they part with their nitrogen.

As has been explained, it is the water-soluble phosphoric acid which gives value to the superphosphates. The less soluble forms of citrate and insoluble are calculated to be worth a little less money, on account of their slower availability.

To determine the value of any manure, all that is necessary to do is to multiply the percentage of each ingredient, stated on the certificate to be present, by the unit value assigned to such ingredient, the result being the value of that substance in a ton of manure. For example, the manner of arriving at the value of a superphosphate from the following imaginary certificate would be—

	Per cent.		s.	d.		£	s.	d.
Phosphoric Acid—Water soluble ...	17.5	= 17.5 @	5	3	=	4	11	9
Phosphoric Acid—Citrate soluble	1.7	= 1.7 @	4	8	=	0	7	10
Phosphoric Acid—Insoluble ...	0.8	= 0.8 @	1	0	=	0	0	9
Total	20.0	Total real value,				£5	0	4

If this manure could be purchased for or about £5 per ton, it would offer very fair value to the purchaser. If, on the other hand, a farmer were simply to judge of the worth of a manure from the total amount of phosphoric acid stated by the certificate to be present, it is possible he might deceive himself as to its real value. For example, let us assume that two superphosphates are offered, the total amount of phosphoric acid in both being 21 per cent. It is possible that they may differ in real value as follows:—

No. 1.

	Per cent.		s.	d.		£	s.	d.
Phosphoric Acid—Water soluble ...	19.2	= 19.2 @	5	3	=	5	0	9
Phosphoric Acid—Citrate soluble	0.7	= 0.7 @	4	8	=	0	3	3
Phosphoric Acid—Insoluble ...	1.1	= 1.1 @	1	0	=	0	1	1
Total	21.0	Total real value				£5	5	1

No. 2.

	Per cent.			s.	d.		£	s.	d.
Phosphoric Acid—Water soluble ...	14.6	=	14.6 @	5	3	=	3	16	7
Phosphoric Acid—Citrate soluble	3.8	=	3.8 @	4	8	=	0	17	8
Phosphoric Acid—Insoluble ...	2.6	=	2.6 @	1	0	=	0	2	7

Total 21.0 Total real value £4 16 10

The difference between the real values of the two manures is 8s. 3d. Now, if both these manures were on the market at £5 5s. per ton, No. 1 would be excellent value, and No. 2 not so good. The difference of 8s. 3d. per ton would pay the railway freight per ton to many country towns. If we take notice of the value of the water soluble portion only in both the manures quoted above, it will be seen that there is a difference in favour of No. 1 to the extent of £1 4s. 2d. per ton. This is an enormous difference, and yet, to the uninitiated, both of these manures appear to be of equal value, because their total content of phosphoric acid is the same.

In the estimation of the value of a bonedust, particular attention should be directed to the "mechanical condition, *i.e.*, the percentages of fine and coarse material present. For example, the value of a bonedust is arrived at as follows:—

> Nitrogen, 3.25 per cent.; total phosphoric acid, 22.60 per cent.; mechanical condition, fine, 35 per cent., coarse, 65 per cent.

$$\left.\begin{array}{l} \dfrac{35 \times 3.25}{100} \times 11/- \quad = \quad 12/1 \\[2ex] \dfrac{65 \times 3.25}{100} \times 9/6 \quad = \quad 19/11 \end{array}\right\} = \text{Value of Nitrogen, } \pounds 1\ 12\ 0$$

$$\left.\begin{array}{l} \dfrac{35 \times 22.60}{100} \times 4/8 \quad = \quad 36/9 \\[2ex] \dfrac{65 \times 22.60}{100} + 3/- \quad = \quad 43/9 \end{array}\right\} = \text{Value of Phosphoric Acid, } \pounds 4\ 0\ 6$$

Total value of the bonedust £5 12 6 per ton.

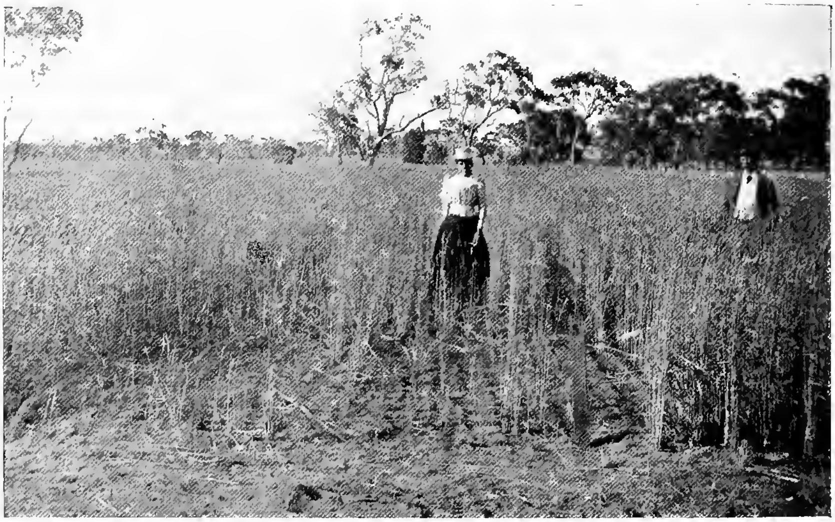
It will be observed that the value of the coarse material for both nitrogen and phosphoric acid, in a manure having the above certificate, outbalances the value of the fine material. Such a manure could only be considered a slow-acting one.

Summary of the Artificial Manures Acts 1904-5.

The chief provisions of direct interest to the farmer with regard to the laws relating to artificial manures at present in force in Victoria are as follow :—

1. The Acts do not apply to the sale of manure when the quantity sold is less than ½ cwt.

2. Upon the sale of any manure the vendor shall give the purchaser an invoice certificate or warranty stating (*a*) the name and place of business of the vendor, (*b*) the distinguishing mark or brand of the manure, (*c*) the quantity sold, (*d*) the percentage which it contains of each of the following ingredients—nitrogen, phosphoric acid, and potash, and the forms in which they respectively occur.



50 lbs. Ord. Super. 18⅓ Bushels. No Manure. 8½ Bushels. 30 lbs. Con. Super. 18 Bushels.

3. Every person who sells or offers or exposes for sale any manure shall securely affix conspicuously to each parcel thereof a plainly printed label bearing similar information. Every such label shall be deemed a representation or warranty by the vendor of the truth of the matters certified thereby.

4. Any purchaser of manure may, on payment of a fee of £1 1s., be entitled to have a sample of manure analyzed by the Chemist of the Department of Agriculture, or any Official Analyst under the Act. As already explained, there is a fixed "margin" allowed to the manufacturer of all manures, within which the quality of the article sold must be kept.

5. In case the purchaser intends to take proceedings against the vendor or his agent, written notice must be sent within fourteen days after the delivery of the manure, and the method of proceeding is specified by the Act to enable both the purchaser and the vendor obtaining parts of the same sample of manure for their respective analysis. The written notice to the vendor may be sent by registered letter through the post-office.

6. If the vendor or his agent does not within ten days after the receipt of the notice accept the offer of the purchaser to divide a sufficient sample of the manure for the purposes of analysis, the purchaser may send his sample to an Official Analyst at any time within one month of his originally sending notice to the vendor.

7. Any person fraudulently tampering with a parcel of manure so as to interfere with a fair sample being taken is liable to a penalty of £5 for the first offence, and £20 for any subsequent offence.

8. For the purpose of ascertaining whether the provisions of the Act are being complied with, the Chemist of the Department of Agriculture or his deputy may at any reasonable time have access to the stock of manure on the premises of the manufacturer, importer, or dealer, and may take samples either before or after they have been sold.

9. In order to obtain information with regard to the quality and prices of the manure offered for sale, it is provided that every manufacturer and importer shall during the months of October and November forward to the Department of Agriculture samples of the various manures which he proposes to offer during the ensuing season, and the prices at which such manures will be sold by himself or his agents. From the results of these analyses as compared with the prices asked per ton, the unit values for the ensuing season are calculated. The unit value is the average cost of 1 per cent. of any given ingredient per ton of manure. The average unit values obtained from the samples sent in during the months of October and November constitute the basis for calculating the values of all manures for the ensuing twelve months.

10. On the completion of the analysis a list is published in the *Government Gazette* giving the composition of the samples and the prices asked for the same, and showing also their valuation according to the average unit values as calculated from the analysis.

11. Supplementary lists of all samples forwarded for analysis under the provisions of these Acts, and of all samples of manures taken for the purposes of analysis, are also published from time to time in the *Government Gazette*.

12. Lists as published in the *Government Gazette* may be republished for public and general information in any newspaper circulating in any part of Victoria without rendering the proprietor or publisher liable to any action or proceeding in any court whatsoever.

CHAPTER VIII.

WHEAT: INCREASING THE AVERAGE YIELD PER ACRE.

There are several reasons why every farmer in Victoria should do what can be done to increase the average yield of next year's wheat crop. Indications point to the fact that the world's supply is once more falling behind the demand. Prices are buoyant, and there is every prospect of an advance —slight it may be, but still sufficient to make all the difference between profit and loss to many a struggling farmer. Every additional bag exported means so many more shillings added to the permanent capital of the State. Every bushel handled by the railways adds to the progress of our great national asset. Up to date methods of wheat growing mean additional live stock on the farm. Sheep and lambs have to be studied as well as the crops. Farm machinery is much more efficient, but needs more skill to work it successfully through the season. Hence the farmer requires to be more thoughtful, alert, and energetic than ever. Successful wheat growing is therefore educative in the true sense of the word.

Wheat stands above average grain crops on account of the very satisfactory yields which are obtained with a minimum amount of rainfall. On favorable soils its roots penetrate four or five feet in depth, so that the plant is able to a great extent to subsist on the subsoil water. A medium crop taxes the fertility of the soil but little compared with the enormous amount of plant food in even the poorer class of soils. The problem of the farmer is to make this plant food available for the crop, and to conserve as much moisture as possible in the soil. Of the necessary plant foods phosphoric acid is that which first becomes deficient in available form. Hence successful wheat growing is in most districts bound up with the questions of fallowing, cultivation, and superphosphates.

Before entering into details, the following figures will give some idea of the Victorian contribution to the world's wheat crop.

AUSTRALASIAN WHEAT CROP FOR SEVEN YEARS.

Year ended March.	Victoria.	New South Wales.	Queensland.	South Australia.	Western Australia.	Tasmania.	New Zealand.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1899	19,581,304	9,276,216	607,012	8,778,900	870,909	2,303,512	13,073,416
1900	15,237,948	13,604,166	614,414	8,453,135	966,601	1,101,303	8,581,898
1901	17,847,321	16,173,771	1,194,088	11,253,148	774,653	1,110,421	6,527,154
1902 ..	12,127,382	14,808,705	1,692,222	8,012,762	956,886	963,662	4,046,589
1903 ..	2,569,364	1,585,097	6,165	6,354,912	970,571	876,971	7,457,915
1904 ..	28,525,579	27,334,141	2,436,799	13,209,465	1,855,460	767,398	7,891,654
1905 ..	21,092,139	16,464,415	2,149,663	12,023,172	2,005,146	792,956	9,123,673

World's Wheat Crop.

	1899. Bushels.	1900. Bushels.	1901. Bushels.	1902. Bushels.	1903. Bushels.	1904. Bushels.
North America .	616,551,000	586,360,000	850,693,000	781,120,000	727,787,000	650,000,000
South America .	125,141,000	120,546,000	87,417,000	73,412,000	132,223,000	128,000,000
Europe ..	1,520,971,000	1,495,135,000	1,492,297,000	1,773,249,000	1,796,311,000	1,640,500,000
Asia .. .	422,642,000	332,219,000	398,857,000	380,473,000	471,390,000	440,000,000
Africa ..	42,373,000	43,600,000	43,400,000	48,000,000	45,400,000	46,000,000
Australasia .	48,580,000	54,880,000	42,583,000	19,820,000	82,042,000	63,700,000
Total world .	2,776,258,000	2,632,740,000	2,915,247,000	3,076,074,000	3,255,153,000	2,968,200,000

UNMANURED STRIP THROUGH PADDOCK, JEPARIT.

Victoria by Counties, 1903.

—	Acres.	Yield.	Approximate Average.
Bourke	2,953	49,482	17
Grant	2,757	46,975	17
Dalhousie	6,305	86,201	13
Talbot	15,231	287,898	19
Ripon	38,562	590,937	15·3
Dundas	2,501	34,903	14
Lowan	147,183	1,982,825	13·5
Borung	424,224	5,800,568	14
Kara Kara	109,413	1,747,420	16
Weeah	19,788	245,206	12
Karkarooc	262,963	2,830,194	11
Tatchera	245,723	2,945,289	12
Gunbower	36,687	533,406	14·5
Gladstone	93,021	1,551,823	16·5
Bendigo	93,575	1,735,104	18·5
Rodney	122,471	2,130,836	17·4
Moira	292,888	5,031,670	17
Delatite	9,070	160,335	18
Bogong	33,243	577,618	17

Experimental Investigations.

The great fact which the grower has to bear in mind with regard to a crop of any kind, is that while the plant secures a great part of its substance from the atmosphere (through the medium of its green leaves), there remains an all important part which can only be obtained from the soil. This portion is chiefly elaborated from the nitrogen, phosphoric acid, and potash of the soil. The difference between good and bad soils consists almost entirely in the ease with which the plant can obtain these materials.

DART'S IMPERIAL, 1903.
A Good Rainfall; 32½ bushels per acre.

In other words, every farmer must grasp the fact that the food for the plant may be present in abundance, and yet the plant may be unable to obtain sufficient to produce a good crop. The nitrogen, phosphoric acid, and potash must, first of all, be dissolved in the water contained in the soil, and there must be a great superabundance of water over and above what is finally converted into the moisture of the crop. We must, therefore, inquire first into the relationship of the moisture to the soil and to the plant, and then into the relationship of the plant food to the soil moisture.

The Soil Moisture.

Most of the rain which falls in the wheat growing areas soaks into the soil. It is only on exceptional occasions that the amount of the run off seriously diminishes the available moisture. For instance, it is calculated that only 4.6 per cent. of the total rainfall over its whole catchment is discharged by the Avoca at Coonooer Weir. Further north, the run off is still less. Once in the soil the water, for the most part, enters into very important relationship to the minute particles of the soil. Instead of collecting below the surface in little drops and pools it forms a very fine film over the entire surface of each of the tiny grains of sand or soil. It is then invisible to the eye, but the remarkable fact is then accomplished that the water is no longer under the influence of gravity. It moves upwards with the same readiness that it sinks downwards. No better illustration of this condition of the moisture can be given than the well known case of dipping the corner of a lump of sugar into coffee. As soon as the sugar touches the coffee the fluid at once mounts up to your fingers, and if the sugar loaf were a yard in length it would only take five minutes to wet every particle of it. The rate of movement depends on the size of the grains and the closeness with which they are packed together. In other words, it is controlled by the size of the little air spaces between the individual grains. These spaces are large in sand, medium sized in loam, and very small in clay. Left to itself, therefore, the winter's rain sinks a varying depth into the ground, and then begins to move upwards to keep the surface soil moist. As fast as evaporation takes place from the surface the moisture in the subsoil is being drawn upon to make good the loss. Therefore, the all important thing is to find out what can be done to check this evaporation. If you cover the ground with a mulch of old grass, or with a blanket, the surface remains moist under them. The same object is attained if the mulch is made of loose earth, the looseness being so great that the particles are too far apart for the film of water to readily run from the one to the other by mutual contact. A well worked mulch, three inches deep, checks a very large proportion of the evaporation. We have no observations in Victoria to go on, but from American results we know that three inches of well stirred surface soil may prevent the evaporation of from 150 to 200 tons of water per acre in the course of the summer. When, in addition, it is known that a crop of wheat requires to secure 300 to 400 tons of water from the soil in order to produce one ton of dry material, the importance of having a moist subsoil cannot be overestimated. An inch of rain is about equivalent to 100 tons of water per acre. A crop of 20 bushels will require at least 600 tons of water per acre to be absorbed by the roots and evaporated by the leaves. When every inch is of supreme importance the success of methods which conserve the subsoil moisture requires no further explanation. So long as the surface is loose and in fine tilth it is not necessary to stir it again, but after a shower of rain, sufficient to cake the surface, it requires to be at once broken up to restore the mulch, and so prevent evaporation. The value of rain in producing good average crops is seen in the average of 1903, standing at 14.5 bushels per acre, or exactly double that of the past ten years.

The Food Requirements of the Crop.

From a large number of analyses at the Department's Laboratory, carried out by Mr. Pearson and Dr. Howell, we know that the average amount of food substances in the surface foot per acre of the Victorian wheat areas is as under:—

Nitrogen	18 cwt.
Phosphoric acid	11 cwt.
Potash	3 tons.
Lime	3⅓ tons.

A 20-bushel crop (grain and straw) removes about 35 lbs. of nitrogen, 14 lbs. phosphoric acid, and 25 lbs. potash. Compared with the enormous amount in the soil, it would, at first sight, appear unlikely that a few pounds, more or less, of any ingredient could have any great effect on the yield. The explanation usually given is the following:—The plant food in the soil is largely in the insoluble form. Before the plant can utilize it some change must occur which renders it soluble, hence the addition of a soluble phosphate produces results out of all proportion to its amount.

PURPLE STRAW, 1903.

37 lbs. super, and a good rainfall; 34 bushels per acre.

There are difficulties in the way of accepting this theory, but for the present we need not discuss them. There is certainly a great field for the cultivator to make even a small proportion of it available for the plant. Suffice it to say that the practical experience of every farmer, and the uniform testimony of several hundred wheat experimental plots, all point to the fact that it is phosphoric acid, and that alone, which is required by the northern soils. It used to be thought that nitrogen was the chief need, but experience proves this not to be the case. In fact, in some instances, the addition of nitrogen actually reduces the yield. From American experience we know that for the rapid growth of fodder crops we require a good supply of nitrogen, while for a satisfactory yield of grain a long growing period and abundance of phosphoric acid are both requisite. Another reason why nitrogen may even prove deleterious to the crop is owing to the rapid growth of the young plant early in the season. The flag then becomes so rank that a much larger leaf space is exposed to evaporation as the season advances; the water supply of the soil is more rapidly exhausted, and the

RESULTS OF EXPERIMENTAL PLOTS ("A" SETS) IN THE NORTHERN WHEAT DISTRICTS, 1900–1.

AVERAGES OF 85 FIELDS.

Number of Fields.	Number of Plot	1	2	3	4	5	6	7	8	9	10	11	12
	Manure given per acre ..	10 lbs. Concentrated Superphosphate	No Manure	20 lbs. Concentrated Superphosphate	30 lbs. Concentrated Superphosphate	No Manure	50 lbs. Ordinary Superphosphate	56 lbs. Thomas Phosphate	No Manure	50 lbs. Bone-dust	Same as 1 with 36 lbs. Sulphate of Ammonia	No Manure	Same as 3 with 72 lbs. Sulphate of Ammonia
	Cost of manure, per acre, in 1900	1/1½	..	2/3	3/4½	..	2/3	2/3	..	2/3	..		..
16	Serviceton to Nhill district .	12·73 3·85	8·88 ..	14·95 6·07	16·45 7·57	8·89 ..	14·80 5·86	13·40 4·41	9·03 ..	11·54 2·48	13·12 4·04	9·11 ..	14·92 5·81
9	Jeparit to Dimboola district ..	12·44 2·69	9·75 ..	14·21 4·35	15·22 5·25	10·08 ..	14·81 4·76	12·74 2·72	9·99 ..	10·34 ·38	20·95 3·01	9·91 ..	15·20 5·29
1	Longerenong College Farm	26·92 1·25	25·67 ..	30·08 4·36	28·08 2·31	25·83 ..	27·50 1·03	30·00 1·89	27·75 ..	27·91 ·05	23·92 ·95	28·08 ..	30·42 2·34
19	Beulah to Lubeck district ..	17·43 3·12	14·31 ..	18·87 4·73	19·72 5·69	13·90 ..	18·97 4·74	17·64 3·08	14·83 ..	15·98 1·20	17·95 3·27	14·58 ..	19·22 4·64
11	Donald to Boort district ..	18·29 2·35	15·85 ..	19·62 4·00	19·68 4·28	15·18 ..	19·04 3·91	17·27 2·18	15·04 ..	15·74 ·68	17·46 2·38	15·11 ..	18·67 3·56
4	St. Arnaud district	16·17 4·18	11·99 ..	17·99 5·92	18·82 6·63	12·22 ..	19·20 6·78	18·89 6·26	12·83 ..	14·61 1·66	18·51 5·44	13·19 ..	18·79 5·60
5	Lake Boga to Swan Hill district	13·12 1·90	11·22 ..	13·43 2·43	14·62 3·84	10·56 ..	13·55 2·87	13·49 2·69	10·93 ..	11·91 1·21	12·48 1·98	10·33 ..	12·77 2·44
4	Maryborough district ..	15·74 2·30	13·44 ..	17·64 4·47	18·58 5·67	12·64 ..	16·53 3·33	16·57 2·81	14·3 ..	15·92 2·05	13·88 ·45	12·93 ..	15·17 2·19
5	Elmore to Kyabram district ..	13·73 3·01	10·72 ..	15·32 4·60	16·69 5·97	10·72 ..	16·27 5·76	14·79 4·50	10·07 ..	13·35 3·03	13·88 3·34	10·80 ..	13·10 4·30
5	Tatura district ..	17·37 1·80	15·57 ..	18·98 3·11	19·98 3·31	16·48 ..	19·10 2·62	18·51 2·03	16·48 ..	17·86 ·83	18·22 1·44	16·93 ..	18·27 1·34
6	Nathalia to Cobram district ..	11·11 ·88	10·23	11·17 ·94	11·34 1·60	10·24 ..	11·59 1·44	11·45 1·39	9·97 ..	10·43 ·35	10·83 ·64	10·31	11·14 ·83
	Averages of 85 fields ..	15·18 2·80	12·38 ..	16·71 4·38	17·61 5·32	12·24 ..	16·75 4·40	15·64 3·19	12·55	13·91 1·37	15·30 2·77	12·52	16·57 4·05

The first line of figures gives the actual yield in bushels per acre, and the second line represents the gain due to the manure.

1900–1, Rainfall 13 to 25 inches. Average yield for the whole of Victoria, 8·9 bushels.

RESULTS OF EXPERIMENTAL PLOTS ("A" SETS) IN THE NORTHERN WHEAT DISTRICTS, 1901–2.

AVERAGES FOR 94 FIELDS.

Number of Fields.	Number of Plot	1	2	3	4	5	6	7	8	9	10	11	12
	Manure given per acre ..	11 lbs. Concentrated Superphosphate	No Manure	22 lbs. Concentrated Superphosphate	33 lbs. Concentrated Superphosphate	No Manure	51 lbs. good ordinary Superphosphate	54 lbs. Thomas Phosphate	No Manure	46 lbs. Bonedust	51 lbs. good ordinary Superphosphate and 48 lbs. Sulphate of Ammonia	No Manure	51 lbs. good ordinary Superphosphate and 87½ lbs. dried blood
		YIELDS IN BUSHELS.											
	Cost of Manure, per acre, in 1901	1/4	..	2/8	4/-	..	2/2	2/2	..	2/0½	7/11½	..	7/0½
18	Lillimur to Nhill ..	12·17 4·20	7·97 ..	14·28 6·31	15·58 7·65	7·93 ..	14·21 6·28	11·86 3·81	8·05 ..	9·24 1·17	14·18 6·12	8·06 ..	14·33 6·27
4	Jeparit to Dimboola ..	11·53 3·45	8·08 ..	14·95 6·87	15·87 8·00	7·87 ..	13·03 5·16	11·87 3·49	8·37 ..	9·41 1·04	14·17 6·34	7·82 ..	13·31 5·48
4	Horsham	15·29 4·61	10·68 ..	16·68 6·00	18·29 6·17	12·12 ..	18·43 6·31	16·19 3·15	13·04 ..	14·19 1·15	16·84 4·80	12·04 ..	17·08 5·04
12	Warracknabeal to Murtoa ..	12·94 3·40	9·54 ..	14·43 4·89	15·70 6·11	9·58 ..	14·97 5·39	12·53 2·24	10·29 ..	10·66 ·37	15·60 5·42	10·18 ..	16·15 5·97
11	Boort to Charlton	8·35 1·51	6·84 ..	9·13 2·29	9·22 3·29	5·93 ..	9·00 3·07	7·96 1·28	6·68 ..	6·79 ·11	9·33 2.94	6·39 ..	9·43 3·04
10	Birchip to St. Arnaud ..	14·52 3·80	10·72 ..	16·36 5·64	17·74 6·72	11·02 ..	16·22 5·20	14·01 3·21	10·80 ..	11·70 ·90	15·92 5·56	10·36 ..	16·01 5·65
2	Stawell to Ararat	16·16 3·83	12·33 ..	19·49 7·16	20·66 7·08	13·58 ..	20·91 7·33	18·58 5·42	13·16 ..	15·50 2·34	19·50 7·09	12·41 ..	20·74 8·33
7	Bendigo to Maryborough ..	17·14 3·51	13·63 ..	18·81 5·18	19·43 6·77	12·66 ..	17·37 4·71	16·74 4·66	12·07 ..	14·86 2·79	16·69 3·92	12·76 ..	18·91 6·14
10	Tatura to Shepparton ..	16·33 2·70	13·63 ..	17·62 3·99	17·95 5·27	12·68 ..	17·87 5·19	16·63 3·41	13·22 ..	14·45 1·23	17·85 5·47	12·38 ..	19·66 7·28
5	Cobram to Nathalia	10·82 ·36	10·46 ..	12·49 2·03	13·68 2·57	11·10 ..	13·04 1·94	12·40 1·01	11·39 ..	11·25 ·14 loss	12·30 1·86	10·44 ..	12·70 2·26
6	Yarrawonga to Rutherglen ..	16·24 3·08	13·16 ..	18·57 5·41	18·69 5·45	13·24 ..	17·85 4·61	18·10 4·61	13·49 ..	15·52 2·03	18·60 6·52	12·08 ..	18·13 6·05
5	Elmore to Echuca	11·49 3·35	8·14 ..	13·57 5·43	15·04 7·23	7·81 ..	12·89 5·08	11·98 3·89	8·09 ..	9·64 1·55	13·29 4·83	8·46 ..	14·12 5·66
	Averages of 94 fields ..	13·58 3·15	10·43 ..	15·53 5·10	16·49 6·03	10·46	15·48 5·02	14·07 3·35	10·72 ..	11·93 1·21	15·35 5·07	10·28 ..	15·88 5·60

The first line of figures gives the actual yields in bushels, the second line the increases due to manures.
1901–2, Rainfall, 10 to 22 inches. Average yield for the whole of Victoria, 6·9 bushels.

crop becomes "burnt up." This is, I think, the explanation of the effect of a heavy dressing of farmyard manure.

The accompanying tables from Dr. Howell's articles in previous numbers of the *Journal* make clear the all important part played by phosphoric acid. It will be seen that, in proportion to the cost of the fertilizer, about ½ cwt. of superphosphate gives the best return, while the result of concentrated superphosphate representing the same value is practically equal. In these tests Thomas phosphate is of distinctly less value, while bonedust has proved a failure. The experiments of the Department, with regard to the exact effect of fallowing and other methods of cultivation, have not yet extended over a long enough series of years to allow of their effects being fully interpreted. Wet and dry years must both be included, but, so far, the results speak unmistakably in favour of the well worked fallow. Last July, Dr. Howell summarized the northern results as follows:—"The pronounced effect of phosphatic fertilizers is only confirmatory of the results of former experiments, but the whole of the present returns tend to show a considerably more marked effect from these fertilizers, under the ample moisture supply of 1903, than under the prevailing drier conditions of preceding seasons. The limits, however, of an effective application, with an ample moisture supply, are lower in these returns than expected, and appear to be somewhat below, rather than above, 80 lbs. of superphosphate to the acre. The natural fertility of the soils under review, judging from the returns of the unmanured plots, may, however, be considered a high one, and on soils below this standard larger quantities would probably prove effective. The wet season appears to have specially favoured the effective action of Thomas phosphate. There appears further, in the returns, evidence for concluding that northern soils, which hitherto, with few exceptions, have remained passive to nitrogenous applications, may show, under an ample moisture supply, a response to such treatment. Indications are also present that continuous grain cropping, year after year, with phosphatic fertilizers may, after some years, lead to soil conditions in which the application of a nitrogenous manure, in addition to a phosphatic, may also become a necessity. It is with the data at present to hand a little early perhaps to draw such conclusions, but the easy possibility of such an occurrence demands attention. Such a contingency suggests the advisableness, where the three year course of crop, grass, and bare fallow is not the practice, of occasionally intervening some leguminous winter crop, such as peas, the cost of which might be profitably covered by feeding off in spring. Such a practice has, in instances, been successfully carried out in the north. The returns appear also to show that the use of small quantities of gypsum mixed with the superphosphate may prove of some slight value on certain soils of the north, deficient possibly in lime or of a mechanical condition tending to set the soil and interfere with the development of the plant in its earlier stages of growth. The few tests carried out on different methods of applying manures favour largely the application with the drill, equal quantities of superphosphate applied broadcast as a top dressing after sowing the grain, as well as ploughing in prior to sowing, showing considerably smaller yields than those obtained from the applications made with the drill." Whether bonedust and Thomas phosphate reveal their effect in subsequent years remains to be seen.

Varieties to Grow.

Owing to the fact that rust is by far the most formidable disease that the wheat has to encounter, efforts have long been directed towards obtaining a rust proof variety. In 1868, the South Australian Royal Commission recommended Purple Straw and White Tuscan as best for this purpose, and the former variety, together with its numerous offshoots and modifications, steadily holds its own. Each district, in fact, has its favorite, and the soundest advice that can be given to the grower is simply to follow the lead of the most successful man in the district, and to remember that while variety is important the results of thorough working and manuring cannot be overestimated.

In 1903-4, the following varieties gave the best yield at the Wagga Government Farm (*N.S.W Agric. Gaz.*). The rainfall was 19.4 inches, 4·7 of which fell in September and October. In each case the crops were grown under conditions appertaining to ordinary farms:—

VARIETIES OF WHEAT WITH 60 LBS. SUPER. TO ACRE, COSTING 2s. 9d.

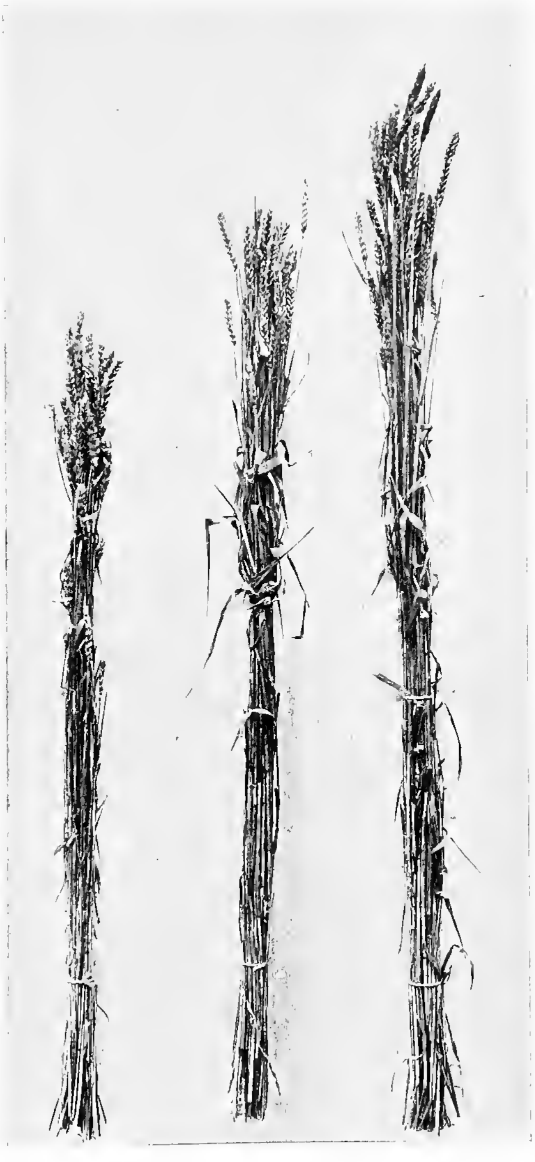
	bush.	lbs.		bush.	lbs.
Federation	38	11 per acre	White Essex	32	16 per acre
Steinlee	35	27 ,,	Plover	31	21 ,,
Steinwedel	34	30 ,,	White Tuscan	29	10 ,,
Hudson's Early	34	6 ,,	Bobs	29	7 ,,
Nonpareil	33	44 ,,	Farmers' Friend	28	29 ,,
John Brown	32	27 ,,	Field Marshal	28	14 ,,
Schneider	32	13 ,,	Dart's Imperial	24	35 ,,

20 to 40 lbs. of seed drilled in gave practically the same yield.

Farmers to Farmers.

The following return, compiled by permission of the proprietors of the *Argus* from replies received during January, 1905, shows the methods adopted by representative farmers in all parts of Victoria. The advantages of fallowing are strikingly brought out.

Name	Locality.	Acres, Fallowed.	Seed, lbs. per Acre.	Super. lbs. per Acre.	Yield. Bushels	Corresponding Yield on Unfallowed Land.
A. McPherson	Wycheproof	80	45	30	16	10
J. Sloane	Inglewood	80	60	60	18	10
... ...	Yarrawonga	60	40	40	26	16
F. LeLievre	Lake Boga	300	25	30	5	...
J. H. Gross	Horsham	100	60	30	32	12
R. Stanley	Pimpinio	250	45	30	16 to 20	7
J. Lamrock	Dookie	70	45	51	28	...
C. Nowotna	Kewell	200	45	45	24	7
H. Adams	Laen	190	45	33 to 50	24	12
English Bros.	Kerang	500	45	.	10	5
W. Petering	Minyip	340	40	35	25	10
J. Sanders	Jeparit	330	45	40	16	10
D. Whyte	Dooen	160	45	40	19	...
Dufty and Sons	Netherby	200	40	50	14	7
H. Allen	Willenabrina	250	40	40	9 to 15	5
W. J. Vaughan	Streatham	6,000	60	56	25	...
H. Sutherland	Lara	120	60	60	25	...
Ford Bros.	Katandra	100	45	45	16	10
J. Ferguson	Beulah	220	30	50	9	3
J. H. Champness	Kaniva	250	45	56	20	10 to 12
H. P. Anders	Murtoa	200	45	30	32	...
W. Kendall	Brim	340	30	56	20	10
G. Pagan	Ardmona	70	60	56	30	16
Gardiner Bros.	Skipton	100	65	65	25	10
J. McCallum	Antwerp	100	40	60	24	8
T. Millear	Wickliffe Road	600	90	80	20 to 28	12
G. Fairbairn	Lara	900	75	(Bonedust) 80 to 112	17	9



EFFECT OF SUBSOILING.

(1) Ordinary ploughing, no manure. (2) Subsoiled, no manure.
(3) Subsoiled and manured.

THE GROWING OF WHEAT.

Process of Fallowing.

For the recovery of grain sick land, and its after maintenance in a state of permanent fertility, it is necessary to resort to fallowing, because in this remedy and the systematic application of manure consists the chief factors which convert the unavailable plant food into a soluble or available form. These are moisture, atmospheric agencies and sunlight. Therefore a perfect fallow should be—first, one in which the maximum amount of moisture is retained in the soil during the summer; second, one in which the soil has been worked in such a manner that the air has had free access to as great a depth as possible; and third, one that has been kept free of weeds. The best practical experience of fallowing teaches that as soon after harvest as the soil will permit the scarifier should be run through the stubble lands. This gives the air free access to the soil through a good part of the summer. Then when the first rains come the weeds will start earlier and more regularly than if the soil were unworked. This provides good early feed for sheep, which should be allowed to graze on it as long as it lasts. Directly seeding is finished on the other sections of the farm, the plough is now put into the land intended for fallow, and the land ploughed as deeply as the soil will permit, without turning up to the surface the raw subsoil. Subsoils are better to be deeply stirred, but not brought to the surface excepting by slow degrees, say about quarter of an inch at each new ploughing season, so as to give the crude soil time to become mellowed and ameliorated by the weather. A great batch of cold raw subsoil suddenly ploughed up to the surface will make the paddock unproductive for several years, as many a selector in the Goulburn Valley has learnt to his cost. Do not harrow after this fallow ploughing, but leave the soil rough and open during the winter. About the beginning of October or late in September this is cultivated again lightly, just deep enough to bury weeds without turning up much of the moist soil from below. If the moist soil from below is brought to the surface just as the hot weather is commencing there is a loss of moisture through evaporation, and that must always be avoided.

After the second cultivation of the fallow the soil is worked down to a good tilth with the harrows, and left as bare fallow, or a fallow crop sown, with such as, for example, rape. If it is intended to sow a fallow crop, give a light dressing of bonedust. It helps the rape considerably, and if fed down with sheep very little of the manurial properties of the bonedust will be lost to the succeeding wheat crop. Having had six or seven months' time to decompose a good deal of it is ready for immediate use when the young plant is germinating, and consequently the wheat crop gets a good start. Whether a fallow crop be grown or not, the fallow should be kept loose on the surface and free from weeds. Fallowing is the only system to insure early sowing for next year's crop. After the very earliest autumn rains, when the weeds have started, scarify once and get the wheat in with the combined seeding and manuring drill. Thus the young plant gets the benefit of the warm, genial weather of autumn, and makes a fairly good start before the cold of winter sets in; it gets a better chance to stool well, and is altogether better able to withstand the dry weather usually to be expected towards the end of the year.

Practical Object Lessons.

In the writer's experience the most reliable information is to be obtained by discovering the men who are conducting their operations in the best and most profitable manner; and describing their work for the guidance and instruction of others. Theory has its value, but theory by itself is misleading. Theory has to be tested by actual practice, because of the various conditions influencing differences in locality. As an example may be taken the question of manures. Theoretically, a chemical analysis of the soil should definitely instruct the farmer as to the kind of manure he requires, but it does not. The only reliable means is to put in alternate strips of crop with different manures, and test the results. So also with every other class of experiment. Theory is good in the way of general direction, but accurate and definite information is obtainable only by practical demonstration. The only information of real value is to be obtained from the man who actually does things, and mere theoretical assertions about how things ought to be done are comparatively worthless. A single example of a well worked farm must suffice.

In this connexion, a profitable illustration is found in the farm called Baangal. It and the land of the surrounding district is capable in its unimproved condition of carrying at the utmost a sheep to the acre, but the Baangal railway way-bills, including fat sheep, fat lambs, wool, wheat, and oats, aggregate more than some of the neighbouring properties ten times its area that are worked for wool producing exclusively. The locality is in the county of Ripon, near the quaint little township of Skipton. The owners are the Messrs. Gardiner Brothers, the elder brother, Mr. John H. Gardiner, being the practical manager. The system is grain and sheep, the latter of the best, and the former worked on a well ploughed sheep fallow rotation, with the seed, after careful screening, drilled in together with phosphatic manures. The fallows are not allowed to lose a year by lying bare, but are utilized for growing rape. Remembering always that this land, in its unimproved state, is barely up to a sheep to the acre grazing capacity, and that its natural quality is by no means promising from an agricultural point of view, what is being done here in the way of raising heavy annual yields of cereals and rape by means of thorough tillage of the soil, and the use of artificial fertilizers, is something that marks Mr. Gardiner as among the limited number found in various parts of Victoria that are doing so much good service to the country in practically demonstrating its possibilities of development.

From 250 to 300 acres are annually cultivated for wheat and oats, about 150 fallow (on which the rape is grown), an average of 4,500 sheep shorn, including stores purchased for fattening. The property, which is 2,250 acres in extent, carries in addition 50 head of cattle and 40 horses. The studs and main flock sheep are of first class merino strains, partly Tasmanian and partly Carngham blood, and the lambs for fattening are a cross with the merinoes and the Shropshire. Two rape crops, one in the autumn and the other in the spring, are grown, and from the two crops of rape an average of five months' fattening during the year is obtained at the rate of eighteen sheep and lambs to the acre. These are big figures, but they are not overstated. There is, of course, an important feature in the district's rainfall, which averages 26 inches per annum, and the rains come very regularly throughout the year. For the autumn rape the seed is sown in March, and for the spring in September. The rape is drilled in at the rate of 4 lb. per acre, together with 112 lb. of superphosphate, which many might regard as a somewhat heavy dressing, but in Mr. Gardiner's experience it is found to pay well not only as regards the crop itself, but also in the after effects upon the cereals which follow. The rape has a fertilizing effect on the land, and the heavier the rape the heavier are the succeeding wheat and oat crops. Bare fallow is good, Mr. Gardiner finds, but rape fallow is better, and the liberal dressing of artificial manure gives its profit in the more prolific growth of the rape. With the 4 lb. per acre of rape at seeding time, is also mixed 1 lb. of mustard, which is found a good corrective against the tendency to "bloating" in rape fed sheep. This remedy Mr. Gardiner refers to as of great value to him in the saving of losses which occurred before he became acquainted with the expedient. At least 10 acres of peas are annually grown, as another green manuring crop, while the peas come in for pig feeding, which is also here found one of the good paying things.

From the impression of this country gained from a look at the big runs outside of Baangal it is difficult to credit Mr. Gardiner's statement that his wheat crops last year averaged 6 bags (24 bushels), and his oat crops 10 bags (40 bushels) per acre all round, but seeing is believing, and the crops as seen this year were quite up to, if not beyond, these yields. The soil in its virgin grazing state is of a thin greyish character, but it has a good substantial subsoil of loam that appears to respond even more effectively than richer land to good ploughing, fallowing, and the application of phosphatic manures. One field of wheat (Tuscan), 135 acres, sown with 50 lb. per acre of seed, and 50 lb. of super., as seen (date 8th December last), presented a delightful sight in its uniform quality, about 5 feet in height, regular throughout in its thickness and levelness, the ears long and well filled with plump berries of grain, just passing from the green into the ripening stage; and last, but not least, absolutely clean. This crop, with every appearance of yielding from 25 to 30 bushels per acre, was a very definite proof of the benefits of the rape fallow system. To the oat crops (Algerian) the same description, especially as to yield and cleanness, applies.

Variations in Wheat Yields.

The advance estimates of the Victorian wheat yield this year range from 16,000,000 to 22,000,000 bushels, from an area of about 2,240,000 acres. The average will therefore probably be from 8 to 9 bushels. Yet as compared with this general average there are in every harvest to be found in every wheat district crops yielding 20, 24, and up to 28 bushels alternating with others varying from "too poor to strip" to 3 bushels, 4 bushels, 6 bushels, and 8 bushels per acre. These latter also are invariably the worst with weeds. The good crops are not only the heaviest yielding, but also the cleanest, as compared with the poor ones, among which it is not uncommon to find in an 8-bushel yield only about half of it wheat, and the other half weeds, mainly wild oats. If one farmer can get a regular annual yield of from 20 to 28 bushels per acre, why should his neighbour go on putting up with a 2 to 8-bushel yield, thereby injuring himself in the first place, and in the second place injuring the State by bringing its general average down to 8 bushels as compared with a possible 18 to 20?

These low yields are the cause of the popular impression that they are the necessary outcome of the alleged arid conditions of northern Victoria. especially the extreme north, the Mallee. This, however, is wrong. The dry climate has nothing to do with it. The difference lies altogether in the different manner of handling the land. This is no mere assertion, but is a matter of absolute proof. The pre-estimates already alluded to were obtained first by my own personal inspection before harvest, and second by circulars sent out to practical and reliable men among the wheat growers, asking for their opinions as to "the lowest yield," "the highest yield," and "the general average" in their several districts respectively. In this way the personal inspection and information by circular from the farmers themselves have been made to check each other. Consequently, these annual advance estimates are not the opinion of one individual, but the conjoint conclusions of the very best authorities, viz., the men who are engaged in the growing of the wheat. Altogether, 75 of these circulars were returned, filled up with the answers, and the information they contain places beyond doubt the fact that the heavy yields are the result of the proper working of the land, and the poor yields the result of the improper working of the land. The assertion that difference of climate is the cause is proven to be wrong by the fact that the heavy yields, whether in the southern belt, which includes the Goulburn Valley; the middle north, which includes the Wimmera; or the extreme north, that comprises the Mallee, are all grown side by side with the poor yields.

Here are some representative examples:—County of Lowan, northern country: Mr. J. C. Farmers, in his letter, says—"Lowest yield, 5 bushels; highest, 20." Yet the general average of the county only reaches 8½ bushels. In this and the following cases one name, to save space, is selected as a representative example out of the many others in the same districts who favoured me with replies to the questions. County of Weeah, mallee country, Mr. A. J. Barnes reports—"Lowest yield, 1 bushel; highest, 12"; and the general average for this county comes out in my estimate at 6½ bushels. County of Karkarooc, mallee country, Mr. Joseph Lockwood—"Lowest yield, 1 bushel; highest, 12"; and the general average for Karkarooc is 4½. County of Tatchera, mallee country, Mr. H. E. Cuttle—"Lowest yields, thousands of acres too poor to strip; highest, 8 bushels"; and the general average for this county is estimated at 3½. County of Borung, Wimmera, Mr. Thomas Young—"Lowest yield, 8 bushels; highest, 24"; general average for Borung, 9½. County of Kara Kara, middle north, Mr. J. H. Hodgson—"Lowest yield, 3 to 4 bushels; highest, 16 to 20"; general average for this county, 10 bushels. County of Gladstone, middle north, Mr. Hugh Ensil—"Lowest yield, 4 bushels; highest, 24"; general average for Gladstone, 9½. County of Gunbower, middle north, Mr. John Cullen—"Lowest yield, half a bushel per acre; highest, 16"; general average for Gunbower, 6½. County of Bendigo, middle north, Mr. Jas. Curnow—"Lowest yield, 4 to 6 bushels; highest, 24 to 26"; general average for Bendigo, 12. County of Rodney, southern belt, Mr. Thomas Hastie—"Lowest yield, 4½ bushels; highest, 24"; general average for Rodney, 9½. County of Moira, southern belt, Mr. George Russell—"Lowest yield, 2 bushels; highest, 20"; and the general average for Moira is reckoned in the advance estimate at 9 bushels. In this way we have the proof that the poor yields cannot be attributed to any other cause than that of the difference in working, because the highest yields are grown alongside the poorest, not only throughout the relatively moister regions of the south, but alike throughout the very driest of the mallee districts of the extreme north.

Causes of Good and Bad Yields.

In the foregoing it has been proven that the great disparity of yields in the wheat growing districts of the north—varying from 1, 2, and 4 bushels per acre to 16, 20, 24, and 28—could not be due only to climatic or other surroundings, because, as the light and heavy yields were being grown on farms side by side with each other, they must be due to a difference in working the land. What is this difference? In addition to the information obtained as to the relative yields, my personal inspection extends to details regarding the good and bad systems of management respectively, and the replies received from 75 practical correspondents situated throughout the whole of the wheat growing counties all unite in the conclusions that the good yields are due, first, to fallowing, second, to early sowing, and, third, to seed grading. Of course, an equally important factor is the phosphatic manuring put in with the combined seeding and manuring drill; but this is at last so universally admitted that it is now general with even the least progressive farmers. Super. by itself, however, is not sufficient without fallowing, and a feature is that in every case it is stated that the heaviest yields are those from the land that was in fallow the previous year.

Bare Fallow.

There are two kinds of fallow, "bare fallow" and "sheep fallow." In bare fallow the land is ploughed up early in the winter, and allowed to lie exposed to the weather between the date of ploughing and the next seeding season. During the spring and summer the fallow is periodically worked with the cultivator and harrows to kill the weeds, mellow the surface, and conserve in the subsoil the moisture obtained from the winter rains. In this way the disabilities of drought are overcome, because every crop grown on fallow has the advantage of two seasons' rains instead of being dependent upon only one. This is one reason why phosphatic manuring in the north is not as effective on unfallowed as it is on fallowed land, because the manure must have a sufficiency of moisture in the soil to enable it to become active. Early sowing also is only possible by means of fallowing, because the fallow being done during the previous year leaves the land in a prepared seed bed for sowing as early as the cultivator chooses. This has the further advantage of leaving the horses free of seed bed cultivation after harvest, just when they are most wanted for other work, such as for example wheat carting to the railway stations. The non-fallowing cultivator who puts his crop in year after year on the stubbles has the disadvantage of a rush of work after harvest; the risk of late sowing by having to wait for the autumn rains; the danger of a lack of moisture by having to depend upon the rain of one season instead of two; and the constantly increasing foulness of the land, owing to losing the benefit of the fallow killing off wild oats and other weeds.

Sheep Fallow.

"Sheep fallow" is letting a certain proportion of the land lie out to grass after a grain crop, and running sheep on it, the natural grass in the north coming up after a crop thicker and better than the original pasture that covered the virgin soil previous to cropping. Sheep fallowing, while good in itself, however, does not reach its highest point of effectiveness except in combination with bare fallow. In bare fallowing the cultivator generally divides his area in such a way as to provide for taking off two succeeding grain crops; two of wheat, or sometimes oats succeeding wheat, but always getting a bare fallow in at the end of not more than two succeeding grain crops. In the sheep fallow and bare fallow systems combined, the wheat grower works on a three-course rotation of grain cropping, sheep grazing, and bare fallowing. On small farms, 200 acres or thereabouts are broken for fallow each alternate year.

50 lbs. Ord. Super.
18 Bushels.

No Manure.
8 Bushels.

30 lbs. Con. Super.
16½ Bushels.

Taking a farm of 640 acres as an example, there are 600 acres to handle outside of, say, 40 acres reserved for a homestead paddock. The 600 acres are divided into three sections of 200 acres; worked as crop, 200; grass after the crop, 200; and bare fallow after the grass, 200; so that in this way the crop is always grown on the bare fallow. Under this system the general rule is to take two grain crops off after the bare fallow, and under it the sheep have not only 200 acres of stubbles to graze over after harvest, but also the 200 acres let out under grass, together with the 200 acres intended for bare fallow up to about June, when the breaking up begins, together with the weeds and other green stuff that come up on the bare fallow during the spring. This is most successful in keeping the land clean, because the sheep are the best of all weed cleaners, besides giving a profit of their own in fat lambs for the frozen meat trade, and, in addition to that, greatly benefiting the land by manuring. The successful farmers of the north are those who have reached this stage (which, of course, cannot be effected at once, as it necessitates good fencing), and they are also the men who always obtain the highest grain yields, because their crops are always off land that has been prepared for an early seed bed by fallowing during the previous year.

The Best of the Fallows.

Of all the fallowing methods, the rape fallow may safely be described as the best. It has followed upon the earlier bare fallow, the sheep fallow, the combined seed and manure drill, and the finishing complement of the latter—the use of the horse hoe. On the marked advantages of the rape fallow system, special note should be made of Mr. Gardiner's operations at Baangal. This marks the highest development up to date of the fallowing system as applied to grain growing in combination with sheep. The bare fallow system is good in itself as a conserver of the moisture in the soil, and as a cleaner of the land. The summer and spring tillage of the bare fallow kills the wild oats and other weeds, and at the same time conserves the winter rains in the subsoil by what may be called an earth mulching of the surface. Outside of this, however, there is, in the bare fallow system exclusively, the loss of a year's production. The next step in advance was the bare fallow with sheep. Under that system the sheep co-operate most effectively with the summer and spring fallow tillage in the wheat cleaning, besides benefiting the land from a manuring point of view and, in addition, yielding a profit in themselves. Best of all, however, is utilizing the bare fallow in the production of a spring crop of rape for topping up crossbred lambs for the frozen meat export trade. In this way the marketable profits from the sheep and lambs are increased. First, as regards the fact that they can be turned off fat, instead of as stores; second, in the large number that can be kept; and third, in the increased fertilizing value of their action upon the land because of their greater number; and, fourth, in the important manurial effect upon the soil of the rape itself.

On this latter point, Mr. Gardiner's experience is that even if he did not keep sheep at all he would always sow rape on the bare fallow for its fertilizing value alone. This, of course, is quite in accord with science, which teaches that the rape crop adds a large amount of humus to the soil when it decays, and thus greatly improves the water-holding capacity of the soil. That being so, it can be very easily apprehended how much greater the advantages are in also utilizing the rape for lamb fattening, when buyers for the freezing works are now regularly exploiting the country every spring for the purchase of three months' old 38 lb. lambs, at from 11s. to 16s. each, with delivery taken on the farm or station. Mr. Gardiner testifies to having fattened at the rate of 18 Shrop.-Merino crossbred lambs per acre during the last three months of the past year. This is evidence that will bear thinking over both as regards the selling profits from the sheep and the fertilizing effects upon the land. Together with his 4 lb. of rape per acre, Mr. Gardiner also drills in 112 lb. per acre of superphosphate, which many may regard as an unnecessary heavy dressing. It has to be remembered, however, that this fallow is the land that early in the following year is to be sown with the wheat crop, and his experience is that it pays well, first in starting the rape into luxuriant growth with the earliest spring rains, and second in the after effects upon the cereal crops which follow. In addition to this, there is the fertilizing effect of the rape itself, together with the manurial value of so thick a grazing as 18 lambs per acre. Besides, there is no getting away from the actually demonstrated results. Mr. Gardiner's land in its natural state is only up to a grazing average of one sheep to the acre, yet his wheat crops average six bags (24 bushels), and his oats ten bags (40 bushels) per acre, because they are all grain, so absolutely clean is the land. This latter is an important point to the credit of the weed cleaning work of the sheep.

As with Mr. Gardiner, so also is it with Mr. Arthur Murphy, whose place is further along the Skipton-road close in on the edge of the large sheet of fresh water known as Lake Bolac. Mr. Murphy, who, in addition to wheat growing, is largely interested in the export sheep and lamb trade, informs me that from one paddock of 100 acres of rape (drilled in on the bare fallow) he fattened, during October, November, and December of the past year, at the rate of from 16 to 18 lambs and sheep per acre. Also, that he finds the succeeding crops of wheat and oats from the rape fallow always the heaviest, which means yields of from 20 to 28 bushels per acre of wheat, as compared with an average of 9 bushels per acre.

The district round Skipton is specially favoured with regard to the rainfall. During the past 20 years, 24½ inches has been the annual average. This, however, only emphasizes the unwisdom of attempting to grow wheat under any other than the fallow system in the districts further north, where the rainfall does not reach, one year with another, to an average of more than about 14 inches. This position is again further supported by the fact that those farmers in the further northern districts who practise the bare fallow system (not yet having reached even the sheep-keeping stage) are already obtaining annual yields of from four to six bags of wheat per acre, so that the extra profits of combining sheep with the tillage remain still for their future attainment. Also, there is no reason why they should not aim at the rape fallow stage, as however impracticable rape growing may be by the non-fallowing farmer, it does not necessarily follow that such would be impracticable under the moisture conserving fallow system. To compensate for the moisture used by the growing fodder we have the profits from the sheep and the fact that the fibrous roots of the rape as they decay let the rain more deeply into the soil.

56 lbs. Thomas' Phosphate.
19½ Bushels.

No Manure.
14½ Bushels.

Rape Rotation in the Wimmera.

FIRST YEAR.	SECOND YEAR.	THIRD YEAR.
No. 1 Paddock. 100 Acres. CROP.	No. 1 Paddock. 100 Acres. GRASS. (After Crop.)	No. 1 Paddock. 100 Acres. FALLOW. (With Rape after Grass.)
No. 2 Paddock. 100 Acres. FALLOW.	No. 2 Paddock. 100 Acres. CROP. (After Fallow.)	No. 2 Paddock. 100 Acres. GRASS. (After Crop.)
No. 3 Paddock. 100 Acres. GRASS.	No. 3 Paddock. 100 Acres. FALLOW. (With Rape after Grass.)	No. 3. Paddock. 100 Acres. CROP. (After Rape Fallow.)

That the same system may be applied to the North with success is proved by the following instance:—In the accompanying diagram is shown a Wimmera wheat-growing farm of 320 acres, whose owner informs the writer that from information obtained as a constant reader of the *Leader* he has been able to lay it out according to what he believes to be one of the most profitable rotations suitable to wheat-growing, lamb-raising, and keeping the land permanently in heart. This is the third year under which the farm has been worked in this way. As will be seen, the 320 acres are divided into three divisions of 100 acres each, the odd 20 acres being round the homestead. The year before last No. 1 paddock was drilled in on bare fallow with wheat (40 lbs. seed and 80 lbs. manure, half super, and half bonedust), and the yield throughout went five bags to the acre. No. 3 paddock was let lie under natural grass, and No. 2 turned up to fallow, ploughing beginning early in June, and finishing by the end of August. On the fallow, 10 acres of rape were sown broadcast (4 lbs. rape and 1 lb. mustard per acre) the last week in August. During the year he purchased 400 aged merino ewes in lamb to Shropshires, at 15s. each. From them 350 lambs were obtained, fattened on the rape, and sold at 10s. each on the place. The ewes shore 5s. worth of wool per head, and then they were also sold fat off the rape for 17s. each. While fattening on the rape the sheep are described as having been greatly advantaged by having access to the natural grass in No. 3 paddock as a change.

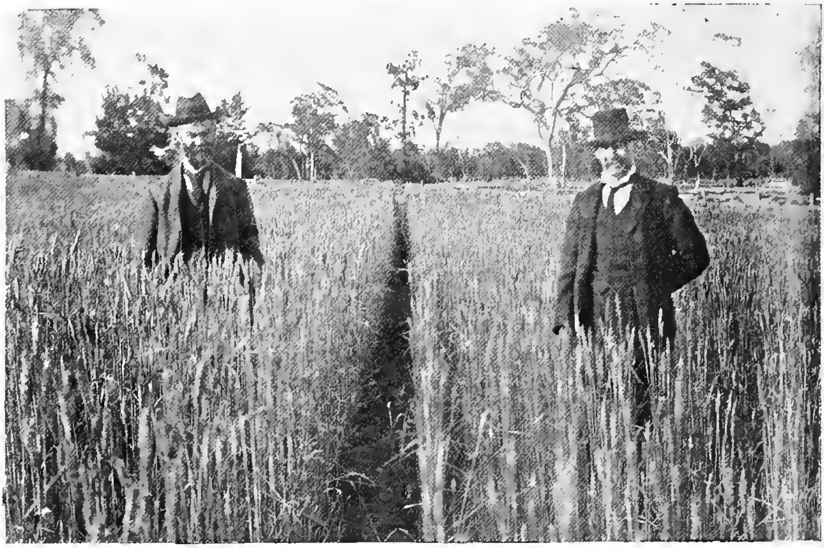
Last year No. 1 paddock was let out to grass after the crop (which gave an average of 22 bushels). No. 2 was cropped, and No. 3 fallowed. On this fallow 50 acres of rape were put in. The number of sheep bought was now increased to 600, consisting of large-framed crossbred ewes, five years old, in lamb to Shropshire rams. This draft of ewes was obtained for 12s. a head. From these, 550 lambs were fattened off the rape, and sold at an average all round of 10s. 9d. each. The ewes gave a return from the wool of 6s. each. This year the crop was sown in No. 3 paddock after last year's fallow; No. 2 let out into grass after last year's crop; and No. 1 turned up to fallow, of which 50 acres were again put in with rape. From the 600 ewes this year 575 lambs were obtained, two drafts of which (100 in each) have already (23rd October) been sold fat off the rape at an all-round average of 13s. 6d. This season's clip of the ewes is expected to reach 6s. worth of wool each in value. The ewes, as they are now in their seventh year, will then be sold to be replaced by another purchase.

While these returns from the sheep can very well be regarded as satisfactory, the owner points out that the benefit to the land is quite as important. The wheat crop this year has every appearance of a six-bag average, and this is attributed to the cleaning and fertilizing effects of the sheep, together with the manurial value of the rape. "It is," he remarks, "certainly a truth that a better wheat crop can always be depended upon from a rape fallow than from a bare fallow. The rape seems to put more into the land than it takes out—at least, as far as wheat-growing is concerned." As to how a 320-acre farm can carry 600 sheep, besides growing 100 acres of wheat, is thus explained. As shown by the diagram, each 100-acre paddock has its regular turn alternately of one year a wheat crop, one year grass, and one year fallow with rape. Consequently 200 acres are available each year for the sheep. It requires to be noted also that the paddock described in the plan as being each year let out to grass, after the crop is not so, strictly speaking, as the sheep on this 100 acres have the advantage of a catch crop sown on the stubbles immediately after harvest. The stubbles being really straw of considerable length after the stripper, has the roller put over it to break it down. Then about 50 lbs. of oats and vetches mixed together with 1 lb. of rape are harrowed in early, so that it comes up together with the self-sown wheat, along with the early autumn showers, and provides good grazing for the sheep right on from the beginning. This, it is submitted, is better than burning the straw, because during the year's grazing it all gets trodden into the soil, together with the sheep manure, as good humus-making and fertilizing material.

Then, in addition to this, the whole of the 100 acres intended for fallowing is available for grazing up to the time of fallowing begins, while the rape for fattening comes in during the latter four months of the year. Another source of feed for the sheep is in the "eating down" of the wheat crop. As the year's wheat crop always goes in on fallow land, early sowing can be easily accomplished; and one of the things that all the best wheat-growers have proved by experience is the advantage of early sowing. This, as a consequence, necessitates eating down, which promotes root growth during the winter, and also that valuable element in successful wheat growing known as "tillering." For eating down, nothing surpasses sheep, as they tread more lightly than cattle. It is further pointed out here that the sheep should be put in only for short periods at a time. All the sheep available, it is explained, require to be put in at once, so as to nip off the tops, and be quickly taken out again, instead of putting in a few sheep and leaving them in too long.

As a profitable rotation, both in actual returns, in keeping the land and maintaining its permanent fertility, this system can be confidently submitted to the consideration of every wheat-grower where the annual rainfall will admit of growing rape. Nominally, an annual average of about

19 or 20 inches is regarded as the minimum for rape, but probably under this rotation, which provides for a moisture conserving fallow not less frequently than every third year, the districts whose rainfall do not reach an average of more than from 13 to 14 inches might also be able to participate. As to the very dry districts, this rotation system only adds to their claim for irrigation, because not a very large quantity of water is required for, say, about 20 acres, and very great would be the productive capacity of even such an area under irrigated rape worked in connexion with this plan of rotation.



20 lbs. Con. Super.
72 lbs. Sulphate Ammonia.
28 3-5th Bushels.

No Manure.
21⅙ Bushels.

Seed Grading.

The next important factor is seed grading. The cultivators who work their land in the manner described in the foregoing keep it perfectly clean, and being clean they are careful to not import weeds into it through the seed. The grader not only screens out all seeds, but rejects all cracked kernels of grain, and further retains only the plumpest and most vigorous seed. They are also careful to select good varieties of seed from other districts, and to avoid running too long upon the seed simply taken year after year from their own crops. Those who argue that the poorest sample of seed selected from their own crop is a saving of money as compared with giving a shilling or two a bushel extra for the best, have the facts against them in the proven increase of returns, both in yield and quality, obtained from good seed, well graded. Just as it was, however, when the opposition to superphosphate manuring and combined seed and manure drilling was so virulent on the part of the unprogressive many at the time when that new system was first introduced about ten years ago, so also, strange to say, is there a similar opposition at present on the part of the non-fallowing wheat growers, in spite of the object lessons presented to their observation annually in the better results obtained by their fallowing neighbours.

A Serious Mistake.

The mistaken idea of many is, largeness of area *versus* working. To get about 1,000 acres in under wheat is depended upon for a big cheque at harvest time, regardless of how it may be disced or scarified in on the stubbles, and also regardless of the fact that 300 acres properly worked would give a heavier total yield, together with the advantage of only having 300 acres instead of 1,000 to sow and travel over in all the processes of tillage and harvesting. Much harm is also done by this class of cultivator occasionally getting a fair crop, and asserting that he has obtained it at less cost in comparison with his systematic working neighbour. These instances, however, only come about at rare intervals. Such an occasion was the harvest of 1903. That year everybody had a good crop, simply because 1903 was an exceptional year for rain, and succeeded the total failure of 1902, which meant that the good crop of 1903 followed the compulsory fallow of 1902. These lucky occasions, however, only happen about once in ten years, and those who gamble for them obtain nine poor crops for the one good one. The systematic worker, however, has a good crop every year, at the same time keeping his ground in good heart and clean, and every year making money while the others are as steadily losing.

Summary.

The demonstrated results of practical experience in connexion with wheat growing and sheep fattening, together with rape fallow, are that, the most profitable way to work a grain growing farm is to divide its area into three sections—one-third to be annually under crop, one-third laid out to grass after cropping, and one-third bare fallow, on which the rape is grown for spring fattening. In the section left out for grass allowed to lie out after a crop, there is no separate sowing down of artificial grasses, as upon the land left out after a cereal crop there comes of itself a good sward of natural herbage. Also under this system it is found best to mix the artificial manures that are put in with the cereal crops at the rate of two-thirds super. and one-third bonedust, because the bones being slower acting than the super., come in better for the grass than all super., which expends itself almost entirely during the crop year. As the general system is to take two grain crops off in succession after the fallow, there is always a run for a good number of lambing ewes as the grazing amounts to well on for two-thirds of the total area. There being only one-third under crop, while one-third is under grass and one-third bare fallow, which latter, in addition to the one-third let out to grass, is also available for grazing up to the early winter breaking up, as well as afterwards for weed cleaning. Then on top of all comes the spring crop of rape for fattening. Apart even from its profitable character in the production of maximum results in sheep and grain yields, a distinguishing feature of this system consists in the permanent keeping of the land in heart. Some anxiety is already making itself felt in connexion with the probable outcome in the future of using superphosphates exclusively as a manure year after year. The fear is that a constant succession of stimulative mineral manuring may eventually have, if not an injurious effect, at all events a decreasing effect in maintaining the earlier crop producing results. Sheep and rape can be better depended upon to restore to the land its important element of humus, and continue to maintain its permanent fertility under the system of alternating the good heavy and clean cereal crops with sheep grazing, and green crop fallowing.

WHEAT UNDER IRRIGATION.

In the Goulburn Valley, irrigation places the farmer under the same conditions as he is in a year of first rate rainfall. He is able to make the moisture in the soil suit the requirements of the crop. We find, therefore, that on well irrigated farms the yield approaches that of 1903. In the one case however, the grower is dependent on the rain, in the other he can, to a large extent, control the forces of nature. My routine practice is to flood the land in March (unless of course there has been heavy rain). A good watering probably represents 3 inches to the acre, and it is all important to have it distributed to every part of the paddock. Then plough as soon as the horses can work without sinking. Five inches deep is a good average, but the point is not to turn up too much of the clay subsoil. Next work it down into a fine tilth with the harrows and roller. The land is friable after the summer, and discs are not often necessary. Sow at once, or, at all events, within a fortnight. Three-quarters of a bushel of wheat, with $\frac{1}{2}$ cwt. super. (costing 2s. 6d.) is about right. If heavy rain comes between irrigating and sowing and the surface has become too puddled for the drill to work well, open it up again with the scarifier, and harrow it down once more.

UNMANURED STRIP THROUGH CROPS.

The one watering followed by this treatment will usually mature the grain. It did it in 1902 when the year's rainfall was only 6 inches. A second watering in spring has two disadvantages. It may bring on rust, and if, in addition there happens to be a wet season the grain may be too soft for the miller. Oats and barley on the other hand should be watered early in spring. It is unsatisfactory, on the average, to water after dry planting.—G. PAGAN.

CHAPTER IX.

THE POTATO.

Though the subject with which this article deals may seem a very commonplace one, it has not received the same attention in the past as wheat-growing or dairying. In the early days, when virgin forests were being cleared off the richest lands in the State, little difficulty was experienced in obtaining heavy yields and first-class quality. No special methods of tillage were then required. Much of the same land is being used to-day for the same purpose in rotation with other crops, such as wheat for hay, barley, oats, and peas. The yields have fallen very considerably, the average return for the last ten years being a trifle over 3 tons per acre. But a more serious aspect of the question is the too well-founded complaint of those engaged in the wholesale trade, as to the difficulty they have in keeping the local market or supplying orders for export. This is due to the inferior quality of many of the varieties grown, and the careless grading of those that are suitable for the trade. It is said that fully one-third of the annual crop marketed is of a low quality, ranging from 20s. to 30s. per ton below the top price.

The Problem.

The question naturally presents itself: Cannot something be done to remedy these defects? What can be done to raise the yield, and what is of equal importance, to produce a crop that will command top price? If the value of one-third of the present season's crop could be increased by 30s. per ton, it would mean between £40,000 and £50,000, or about £1 per acre on the whole potato area of the State, or an amount equal to the annual rent of many first-class farms.

There can be no doubt that a number of causes combine to bring about the condition of affairs above stated. Some of these are: Selection of wrong varieties of potatoes, growing potatoes in unsuitable soil (which is the most fruitful cause of what is called a nasty potato), want of care in the selection of seed, the unsuitable condition of the soil, and neglect of the growing crop. Farmers have their soil analyzed, and are told that it has all the constituents of a first-class potato land, but constant cropping has altered the mechanical condition of it, and rendered it unsuitable for the growth of potatoes, except in a very favorable season. There can be little doubt but that the average farmer understands the best methods of preparing the land he has to deal with, and practises them, and he may be generous in the use of manures, but still his returns are uncertain. The growers are asking each other the question: How are we to get back somewhere near the yields of the early days? The answer must be found in getting back as nearly as possible to the conditions that existed in those days.

Keeping the Land in Heart.

Although the question of renovating the land is of the first importance, it is a comparatively easy matter, and has been solved by the farmer in the great potato belt of the State of Maine, United States of America. This is a tract of country 90 miles long, and 15 miles wide, devoted principally to potato-growing. They have adopted the practice of intercropping with clover, and the average yield is maintained at 4 tons per acre. One-third of the land is under potatoes every year. To secure the renovation of his land the Victorian farmer should combine dairying or grazing with agriculture, sowing down part of his land every year with clover and grasses, making as much manure as he possibly can, and applying it to the land in the fall, where he intends to plant potatoes the following spring.

The climatic conditions are not so easily dealt with. The clearing away of the forests for cultivation and ring-barking of timber on grazing areas, especially on the hills, has had a marked influence on the climate. If it has not decreased the annual rainfall, it has increased the evaporation of moisture from the soil during the spring and summer months, when the potato crop requires all the moisture it can get. It has taken over fifty years to bring about this condition of the climate; it may take twice as long to remedy it. The plan that suggests itself is reforesting the country, planting all the roads and every spare corner on the farms with trees, so as to form wind-breaks to reduce evaporation.

Selection of Varieties.

If the land is sown down and rested for a time, and the rainfall is sufficient, yields will increase; but there is another matter quite as important, viz., the selection of varieties suitable to the soil in which they are to be grown. Some potatoes do better in one class of soil, or one district than another, and this can only be proved by experiment. There is an endless variety of potatoes to choose from, and new varieties are being added every year. It would be well to find out those most suitable for trade requirements, and weed out a number of varieties, keeping only the best. The question will then be asked, what is the best. If for the early market, the choice will be some of the quick-maturing varieties, generally white-skinned. If for later districts, some of the dark-skinned blues and reds are most suitable, as they keep longer, and are the best for export. This is the branch of the industry that requires the most serious attention. It would be little use increasing the crop if it cannot be disposed of; but if the statement is true that the merchants cannot fill their export orders because of the difficulty they have in procuring the stuff they require, then there must be room for improvement. It falls upon the farmers to face the matter, and improve the quality of their produce. If the average is a 4-ton crop, they should be able to market nearly the whole of it in condition fit for export. The question of the selection of seed of any variety is a matter of great importance. The haphazard methods of bygone days must be given up. The various points raised in this preliminary sketch of existing conditions will be treated in detail later on. We will first give a general outline of the conditions necessary to insure success, and assume that many of our readers wish to begin potato-growing for the first time.

General Requirements of the Crop.

The potato crop is one of prime importance to the farmer. In the first place, it should supply a large portion of the potato supply of his home, as well as contribute materially to the rearing of pigs and other live stock on the farm; while, in the second place, in favorable districts, it is one of the most profitable crops the farmer can handle. The potato came originally from regions in North and South America, characterized by very abundant rainfall, but the plant has been gradually adapted to a wide range of soils, of temperature, and of climate. Nevertheless, it may be stated definitely that abundance of moisture is the most important factor towards success. The natural habit is for the new tubers to be produced slightly nearer the surface than the seed was planted, and as the tubers require to be able to increase in bulk with ease it follows that deep, loose, loamy soils yield the best results. These deep soils require to be well drained, for although the potato likes moisture, it soon rots when submerged in water. Most people look upon the tubers as the roots of the plant, but the real roots are the mass of little white filaments which hang in clusters from the base of the stalk. These little fine roots are not only very numerous, but, under favorable circumstances, they extend into the soil much further than they can be readily followed by the eye. If care is taken in washing away the soil from the roots of the potato the combined length of these filaments has been ascertained to amount to as much as 600 yards. This accounts for the fact that the potato is a good foraging plant, extracting large quantities of nutriment if the soil is favorable, and is additional evidence of the necessity for a deep open soil to attain the highest measure of success. While the conditions which govern success, as far as the potato crop for the market is concerned, can thus be fairly definitely stated, there are two other ways in which the potato is especially valuable to the all-round farmer. Owing to the amount of attention that the crop requires in the shape of tillage, it has long had the reputation of being one of the best possible crops for cleaning the land; while, on the other hand, when virgin forest land is first broken up before there is time to clear it of stumps or logs, it often happens that an excellent crop of potatoes can be secured on what looks rather unpromising soil. The explanation is probably owing to the fact that the burn-off has left abundance of ashes containing lime and potash on the surface of the land, and potash is one of the constituents of the soil greatly relished by all root crops. Most of the great potato districts in Victoria—Warrnambool, Lancefield, Smeaton, and Bungaree — are volcanic, and in these volcanic soils potash is usually present in great abundance. Any soil which is mellow and friable, and which can be worked up into a fine loose condition, can be made to produce a good crop, but friable clay loams, rich in decayed vegetable matter, give the best results. The reason why that is so is probably to be found in the amount of organic matter which they contain supplying the necessary food for the crop, while the combination of the decayed vegetable matter and the clay places the soil in the best possible condition for retaining the moisture. On the other hand, it can be seen that the worst of all soils for potatoes are those which become very dry, and which easily clod. Hence it follows that on clay soils the chief aim of the farmer is to prepare his land by draining, working, and incorporating farm-yard manure to such an extent that it loses its tendency to clod after heavy rains. This will also explain the importance of thorough preparation of the soil.

Preparation of Land.

Where possible the land should be ploughed in autumn, thrown up rough in ridges exposed to the effect of the rain and the atmosphere during the winter, and then deeply re-ploughed and worked down to a fine tilth with the disc or other harrows, until the seed bed is made as fine and friable as possible. The extent to which the clod crusher or the roller can be used in these operations is a matter which can only be decided on the spot and at the time. In cloddy ground it is a good rule to be guided as to the application of the roller by the way in which the clods break up when you kick them with the heel of your boot. The roller is doing very little good, or may even be doing great harm to the surface of the land, so long as it simply forces the clods into the soil, and thus produces a level surface. This is the reason why the spike roller has come into general favour—the clods are not only crushed and levelled, but the soil is again loosened with the spikes, so that the rain and air are admitted, and the next heavy rain has less chance of producing a hard crust on the surface. Depth of cultivation, thorough preparation of the land, and a fine mellow seed-bed, are all important. Wherever the water is found oozing out of the soil after a few days' rain in winter indicates a patch of land that requires drainage. Few people know that the superabundance of water in the winter means a corresponding shortage in the summer. Yet this is the case, and the explanation is that water-logged land, when it does dry, loses nearly the whole of its moisture by evaporation. On the other hand, the little particles of a soil in a friable condition cling tenaciously to the moisture, and remain moist long after the sodden parts of a field have become hard as bricks. Drainage, therefore, must not be overlooked. Land which has been previously under cultivation, and is now intended for a potato crop, should receive a dressing of farm-yard manure in the autumn, ploughing it in lightly, say, 4 inches deep. It should then be harrowed and left through the winter to mellow the land, and start the weed seeds. In some cases the manure is applied at planting-time, but in wet seasons this may cause a heavy growth of stalk, and a light return of tubers, or it may cause a good many hollow potatoes. The second ploughing, to the depth of 8 inches or 9 inches, should be given, as soon as the land is fit, after the winter rains, and it is then worked up with the cultivator to a fine tilth. Land from which a crop of peas has been taken will give a good yield of potatoes without manure in the volcanic soils, and in any system of rotation it is as well for potatoes to follow peas, clover, or other leguminous crop. The extra supply of nitrogen which such crops leave behind, through the roots and stubble, goes to increase the fertility of the land, while the deep-root system, which forms one of their chief characteristics, has a marked effect in rendering the soil friable and mellow, making it comparatively easy to obtain a satisfactory seed-bed. There is a good deal of evidence to show that a mealy, fine-flavored potato is largely dependent for these qualities on careful preparation of the land.

The foregoing considerations show how much easier it is to prepare loamy land, and from what we have said as to the part played by a good supply of moisture, it will be seen that much greater liberties may be taken in districts with a good rainfall than in the drier parts of the State. With a rainfall of 40 inches, a good crop can be produced on light sandy soil, and under such conditions good results follow the application of artificial fertilizers. Examples of what can be done on poor, sandy soil, when drained and improved, may be seen in the Brighton district. The friable peaty soil of the drained swamps (such as Koo-wee-rup and Carrum) is also excellent for potatoes. Many of the hillsides of South Gippsland with their grey, loamy soil, give capital crops of potatoes, and this crop is one of the best means to get rid of the superabundant bracken. Where the quality is good, it may be said that quantity will follow as the land is brought into better condition, particularly as regards its water-holding capacity.

Manures to use.

Manuring is a question on which there is a great difference of opinion. However, as regards farm-yard manure, all are pretty well agreed that it is the best in all soils and climates, either worked into the soil by autumn ploughing, or applied as planting time in moist districts, or used as a mulch in the drier districts. It supplies plant food, conserves the moisture, and improves the mechanical condition of the soil. Artificial manures have not been found to give very satisfactory results when applied to the volcanic soils. Light grey or sandy soil must have liberal dressings of both artificial and stable manure. A heavy crop of peas, rape, or clover ploughed down on the potatoes will, in a moist season, give satisfactory returns. In districts where frosts are not severe enough to injure the pea crop, or retard the growth of rape, they should be sown early in autumn, and ploughed down just long enough to allow them to rot in time to work up the fallow. In this way the surest results are obtained from green manuring. In Brighton and Carrum the usual practice is to use 5 cwt. of "nitro-super."* to the acre (equivalent to about 95 lbs. of phosphoric acid and 5 lbs. of nitrogen), with a fair amount of stable manure. English and American experiments show that stable manure alone is much more beneficial than artificial alone, 20 tons of the former raising the yield from 6¼ tons to 10½ tons per acre. Ten tons of farm-yard manure, with artificials representing 35s. per acre, gave practically the same results.

It is found, as regards nitrogen, sulphate of ammonia gives better results than nitrate of soda, and as regards potash, the chloride is better than kainit. As in all other cases, the grower himself should experiment with different combinations, and quantities of artificials, as the results obtained elsewhere are seldom directly applicable to any given farm. In any case, the value of farm-yard manure must be emphasized. It restores the humus which is all-important to the land intended for potatoes. My own experience seems to show that the best crops of all are obtained where the potato follows grass or clover sod, and I feel sure that it is more profitable to plant a few acres of well-prepared land than to risk a larger area only half-tilled.

The Selection of Seed.

It is a good plan always to select a potato of fair size and uniform shape, and true to type. But it does not always follow that a shapely potato is after all the best for seed. It is possible to get a wild potato that will have as good appearance, and cut as white and cook as well as a true one, but it will only yield a crop of undersized and small tubers. The accompanying illustrations will show how easy it is to make a mistake in the selection

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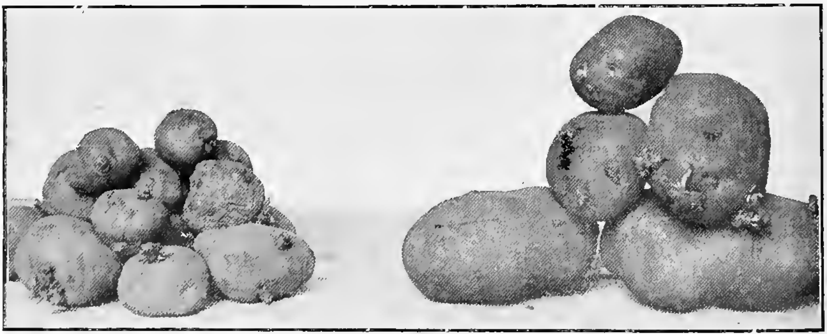
* The requisite weight of superphosphate, &c., can only be given if the percentage composition of the sample is known. This is given in the certificate which accompanies the invoice. See the *Journal*, July, 1905.

WILD AND TRUE SEED POTATOES.

of seed. The farmer may take what he believes to be all true potatoes of the variety he is planting, and at digging time finds he has many stools that return nearly all small ones. The potato No. 1 in the illustration is a wild Brown's River; No. 2 is a true one. They were of the same size, and almost identical in appearance, so much so that had they been in a pit together they would both have passed as good seed; but, being taken from the parent root, there could be no mistake. They were planted side by side in the garden, and No. 3 represents the produce of No. 1, consisting of 23 potatoes; only two were of medium size, the others ranging down to the size of a large pea. No. 4 is the produce of No. 2, and consisted of five large potatoes, all fit for the table. Now, had these two lots been dug in the ordinary way, and carted to the pit, or sent away from the field, every potato on No. 4 would have been sent to market, and part of No. 3 would, in all probability, have been selected for seed. The next season No. 4 was cut into 19 sets, and the same number of sets were selected from the best of No. 3. These were planted beside each other in two drills, 27 inches



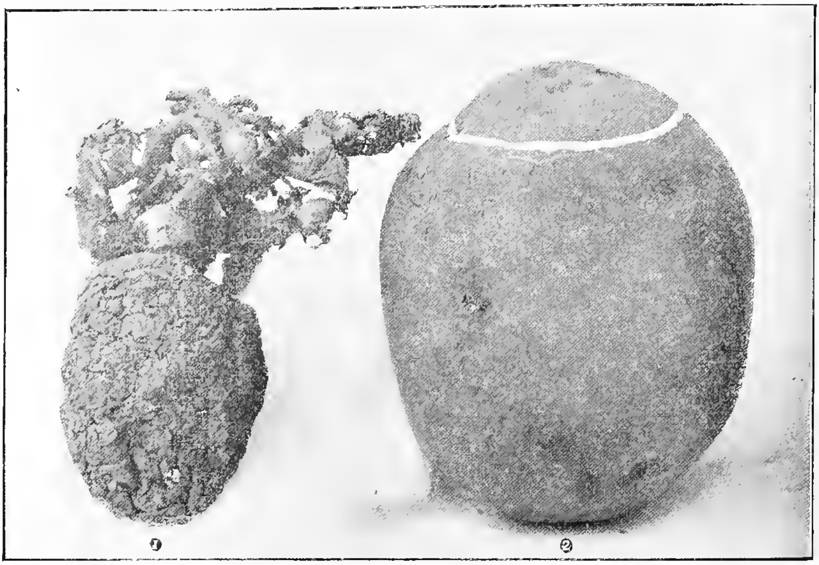
FIRST YEAR'S PRODUCE OF THE SEED.

apart. Both lots were treated exactly alike, receiving the same attention as if they had been planted in the field. The 19 sets from No. 3 produced those shown in No. 5, which had only twelve fair-sized tubers, which are placed at the front of the pile, all the rest at the back being fit only for feeding stock. The nineteen sets from No. 4 produced the large pile shown in No. 6, all of which were fit for table or seed; the few too small for the table are all shown on the outside of the pile. Now, the ordinary practice is to select the seed in precisely the reverse way. Medium-sized or small potatoes are selected; all the marketable ones are sold; no attempt is made to trace the history of what is chosen, and the whole tendency is to breed down instead of breeding up. I feel sure that the mere introduction of new varieties of seed will not of itself do anything more than temporary good. The real cure for the ills that beset the industry is to be found in much greater care on the part of the individual grower, and one thing that requires to be placed on a new footing is the selection of the seed. The selection must be made at the time the crop is dug, not months afterwards. As each root is dug, the whole of the potatoes it has produced, big and little, are spread out on the surface of the land, and the *grower himself* selects the necessary quantity for his next crop before they are bagged. Only those stalks are chosen that have produced a fair number of tubers uniform in size and shape, and without a large percentage of small "pig potatoes." Uniform in character and true to type are the most essential characters. If any farmer will take the trouble, year by year, to select the best seed in this way, he will find the quality of the potato keeps up, and the yield improves, so long as the soil and moisture are right. As an instance, may be mentioned the experience of Mr. Kenny, of the Ballarat Orphan Asylum. He has never changed his seed for 25 years, and says his potatoes (early Rose) are better now than ever. Another point must be remembered. The same potato will not suit all soils and all climates. As a rule, seed *appears* to do best if planted in a slightly warmer district than that in which it was grown. Here, however, the haphazard method of selecting seed makes it difficult to be sure that the improvement is apparent or real. The safe plan is to begin in a small way, to take every care in the preparation of the land, and to use four or five varieties suitable for the purpose aimed at, whether this is the export trade or the early market. The selection of seed from year to year

BAD AND GOOD BREEDING.

from the best of these varieties is then simply a matter of care and patience; but as year by year goes by, the more the type is fixed, and the easier the selection becomes.

For early crop the following varieties are recommended:—Beauty of Hebron, Early Rose, Early Vermont, Carman No. 1, Daniel's Sensation, Duke of York, and Duke of Albany; for main crop and export, Brown's River, Flat Top, and Copperskin.



THE STRONG SHOOT FROM THE CROWN.

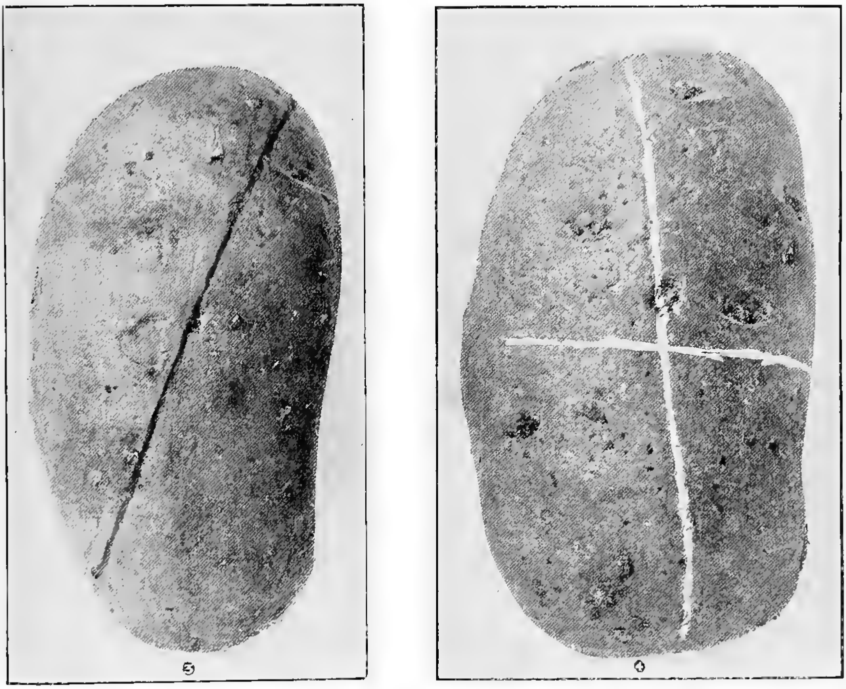
The Care and Preparation of Seed.

1. Keep your seed in a cool, dry place, at a temperature of 35 to 40 degrees Fahr. As possibly no grower has cool storage, a good substitute is a piece of firm, dry ground, under the shelter of pines or other evergreen trees. Spread the tubers out thinly, and turn often. Some growers recommend excluding the light. This is a mistake; the more they are exposed to the light and, if possible, the sun, the hardier they become. A tuber that has become green will resist an ordinary frost, and may remain exposed the whole winter on the surface of the ground without rotting.

2. The matter of cutting seed or planting whole sets is largely a question of £ s. d. On the question of cutting, nearly every one has his own method. Some say cut to one eye; others say plant whole sets; while some hold that the stem end does not produce such good potatoes as the crown. Another will advise to cut the crown off. It may happen that, under certain conditions, all these methods give satisfactory results. But the question is, what is best all round? First, it is not wise to cut to one eye, unless the seed is very strong, the land a first-class potato soil, and in good tilth. Whole seed should be used if the ground is very moist, and the weather warm at planting time, or when green manure is ploughed down on the seed. A large number of experiments have proved that the stem end of a tuber will produce as good potatoes as the crown. Do not cut the crown off, as it is here, as a rule, the strongest shoot starts.

The accompanying illustration will show the value of "greening" seed potatoes and preserving the crown. Potato No. 1 was dug out of the ground early in May, 1904, and was the same size as No. 2. It was exposed to the sun until quite green, then placed on a shelf to sprout. It had been out of the ground seventeen months when photographed, and was then bearing small tubers. Had the crown portion marked by the white line been cut off, it would have sprouted at every eye, and wasted in a few months.

The rules to observe in cutting seed are: First, look for the well-formed eyes, which throw out the strongest shoots, and cut the tuber so as to have at least one to each set. For example, the line drawn across the kidney potato (No. 3 in the illustration) is cut so as to divide the two strongest eyes in the potato. The other method would be to cut it straight across, making a stem and a crown set of it. Potato No. 4 is marked so as to cut four sets, giving each set one strong eye.



METHODS OF CUTTING SEED.

3. In a dry season, or districts with light rainfall, large sets are the best, as the plant in the early stages of growth depends largely on the parent tuber for moisture until well established. It is better to leave more than one eye, as all eyes do not throw out shoots. A large set with many eyes is just as liable to rot as a smaller one with only one eye. It is the condition of the tubers and the state of the land that causes seed to rot. Sets with a single eye should only be planted in well-prepared land suitable for potato growing.

5. Seed should be planted the same day as cut. It is not necessary to use any material to dry the cut sets, as a cut tuber does not bleed. The potato is composed of starch, and naturally dries quickly; if it does not, it will rot if put into the ground. Do not cut more seed than you can plant during the day, for if rain falls your work may be stopped for several days. If the seed gets wet, it will be liable to rot. After rain, do not start planting with cut seed until the ground is dry.

5. The quantity of seed required to plant an acre of land varies according to the size of the seed and the distance between the drills and sets. It may be put down at from 7 cwt. to 10 cwt. of average seed; 6 cwt. of small seed will plant an acre, but very large tubers will run to 12 cwt.

Planting.

The time for planting varies in different districts; but generally in districts affected by frosts it may begin as soon as all danger is over for early crop, and be continued, say, from August or September, for early crop, to December in the later districts. The planting is usually done with a three-furrow plough, drawn by four horses, which will do from 3 to 3½ acres per day, requiring two boys to plant. The drill plough, requiring two horses, is also used in some districts. The drills are opened about 27 inches apart, and the sets are dropped in the bottom of the drill, and this is closed by turning back or splitting the ridges. A team can open 4 acres per day. This method is preferred by some farmers, as it helps to work the land up. The previous ploughing should be very deep, as it is difficult to open drills on shallow ploughed land. After planting, the drills should be harrowed down as soon as possible. Some very good work has been done with the Robbins' potato planting machine, which opens the drill for the reception of the seed, plants, applies the manure, and covers them again. If it is intended to use the planting machine, the land must be brought to a fine tilth before operations begin.

In ploughing in green manure, the crop of peas, rape, or clover should be rolled down as flat as possible by means of a heavy land roller. The plough should be fitted with circular coulters and drag chains to bury the green stuff. Many prefer the short boards of the American single plough, cutting a 14-in. furrow, putting two sods between each drill, or three 9-in. furrows. When using these ploughs the chain can be dispensed with.

The trench system of planting is preferred by some, but can only be carried out on small plots. It is a very old method, and was in general use more than a hundred years ago in Great Britain, and revived in recent years by Mr. Carman, of the *Rural New Yorker*, with varying results. Mr. Kenny, of the Orphanage, Ballarat, has obtained very good results from this method, which is carried out in the following manner:—A trench 12 inches wide and 10 inches deep is opened, and the soil at the bottom is worked up; the manure is then applied; in the case of artificial manure, it is sown broadcast over the trenches; about 5 inches of soil are then returned to the trenches; the seed is planted, and the remainder of the earth is placed lightly on the seed, leaving slight ridges, which soon settle down to the level of the other ground.

The crop should not be planted too deep, about 5 inches being found the most suitable depth. The drills should be from 27 in. to 30 in. apart, and from 18 in. to 24 in. between the sets. The plants when full grown should cover the ground completely, so as to shade it from the sun's rays, and conserve all the moisture. The harrows should be put over the ground as soon after planting as possible, and every week or ten days after, until the plants are, say, 3 in. high, to keep down the weeds, and loosen the soil. Then the horse hoe should be put through the drills, care being taken not to mould up the plants. The hoe should never be used after the plants have sent out their roots, as it will destroy them, many of them being near the surface. The next stage of the crop is the blooming time, and particular attention should be given at this point to plots intended for seed. All plants with false bloom should be pulled up at once. This is a work entailing a great deal of time and attention. Once through will not do, as all the plants do not bloom at the same time, and, if neglected, some of the blooms will fall, and the plant cannot be identified after. They may require to be gone through twice a week for three weeks, or even longer. After a fall of rain is the best time.

Digging.

This is usually done with forks. Machines have not proved a success. All potatoes intended for seed or storing should be thoroughly ripe before being dug. Sometimes it happens that heavy rains in the summer will induce a second growth. As soon as the potatoes show signs of a second growth they should be lifted at once.

Storing and Grading.

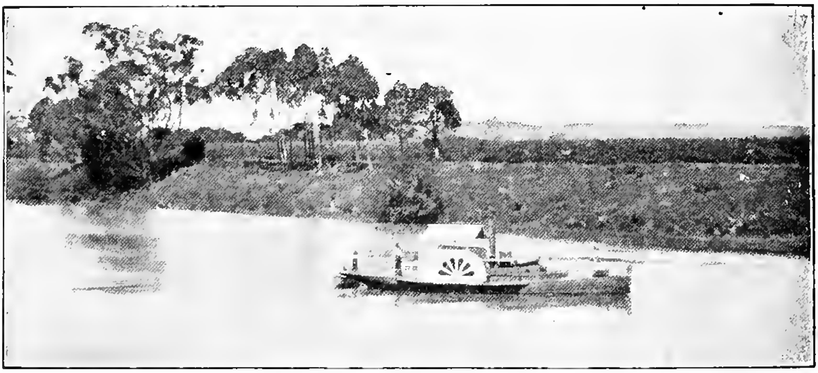
The method of storing is usually called "pitting." The word is somewhat misleading, as it conveys the idea of an excavation in the ground, whereas the potatoes are simply shot out on the surface between two slabs or rails placed from 9 to 11 feet apart, and raised to a height of about 5 feet, with the slope like the roof of a house. This is then covered with a good coat of thatch.

Care should be taken to select only sound and well-shaped tubers, discarding all that may be damaged by the fork in digging, also horny or misshapen ones. Potatoes intended for export should be put up in good bags.

CHAPTER X.

MAIZE.

The first maize planted of any extent in Gippsland was on the Bass River by the Tasmanian Farming Company in 1843, and harvested the following season by the late Mr. Peter Cameron, of Orbost, on behalf of a London company, which he represented in Victoria, this company having made advances on the venture. The method of harvesting was novel. The stalks were cut and placed to dry as if forming tents on little tea-tree fences, but the shelling was simple, for the cockatoos and parrots of a continent came and practically ate up the whole crop. This wound up maize-growing operations on a large scale for the time. Up to 1879 maize-growing in Gippsland was confined to Mr. C. Seehusen, of Bruthen, and a few others on the Mitchell, and only then on very limited areas, partly on account of the want of appreciation by consumers, and partly from the lack of suitable implements and machinery to cultivate and harvest the crop. In 1879 Messrs. Cameron Brothers, of Orbost (of which I was the senior partner), observed an article in the *Leader*, suggesting a system of check planting common in America. The method is this:—Three straight rails, eight feet long, are fastened together on their edge, three feet apart, and parallel, by a strong frame. On the centre of this is placed a box as a seat for the driver, who yokes a pair of horses to the front as for ploughing. With a set of poles he marks out the field the long way; then, in like manner, marks it across. The field, when finished, is left in checks, three feet square. Two men are employed. One, with a small bag of seed, drops three seeds at the intersection of the rows; the other man covers the seed. A

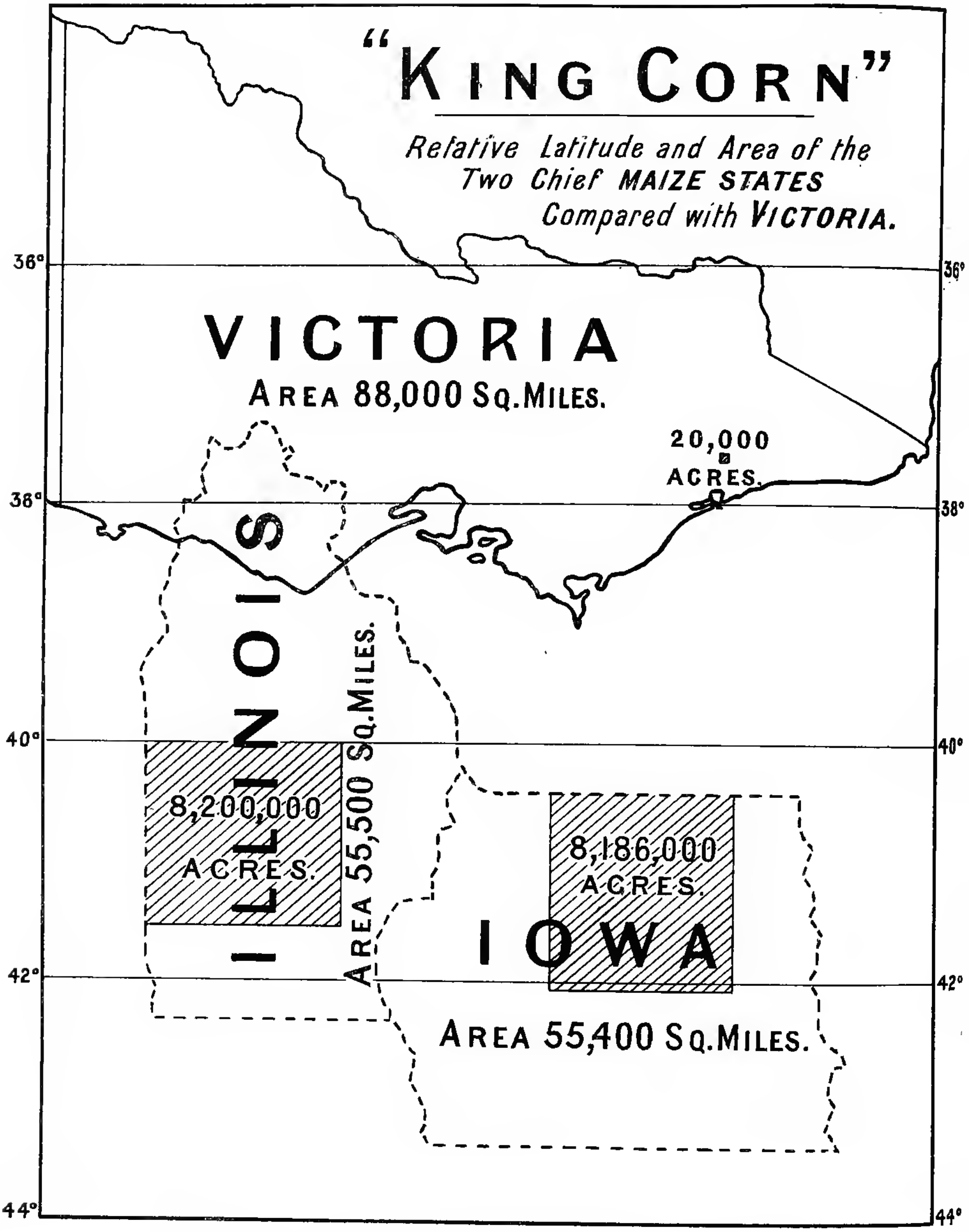


MAIZE CROP ALONG RIVER AT ORBOST.

smart man will plant several acres in a day, working right and left handed. This system enabled growers to work the horse hoe both ways, and in a few years was generally adopted by maize-growers. In 1884 and following years the importation of implements, machinery, and seed grain from America by myself and some of my friends, completely altered the fate of this industry, and put it on a fairly prosperous footing. In the above year the late Mr. Downes imported an Avery check row maize planter for me, which I used on my farm at Orbost. This machine, the first in Australia, was so satisfactory that the following year I imported, through Mr. Downes, a full set of maize implements—stalk-cutter, double riding horse hoes, and gang ploughs. In addition to this, with Messrs. Hossack and J. A. Watt, I imported seven varieties of the earliest ripening seed maize. This resulted, not only in the earlier ripening of the crop and a higher yield, but in a great saving in storing the grain. Owing to the large amount of saccharine matter in the core, the old Gippsland ninety day maize required to be laid on battened floors, and turned frequently to prevent it from developing a mould, whereas the new varieties can be stored in any thickness in cribs or barns until ready for shelling. Then followed the importaton of the fine shelling machine, built by Clayton and Shuttleworth and other firms, capable of shelling up to 600 bags per day. Notwithstanding the fact that we have the most up-to-date maize implements and machinery, the finest climate, and highest yields in the world, maize growing has not expanded as it ought in Victoria when compared with other countries. When we come to think that every river and creek bottom in Gippsland, as well as those of the Mitta Mitta, Kiewa and their tributaries, will give a return of from 60 to 140 bushels to the acre, with proper cultivation, and without irrigation, and if made into ensilage, an average of 30 tons, the possibilities of these districts are enormous. When the time comes that these lands are devoted to this crop and lucerne, the result will be such as few of the land-owners in those districts dream of. Thirty tons of ensilage, the product of an acre, will keep four cows over a year at 40 lbs. per cow per day. When this is fed along with an acre of lucerne, which can be cut four times a year, it is not too much to say that the two acres will carry six milch cows. If this be confined to the milking season of, say, ten months, and the dry cows are turned out to grass for two months, the two acres will keep eight instead of six head during the milking season. As soon as our farmers come to realize that the most profitable way to deal with maize is to associate it with lucerne or some other such crop, and turn it into a product worth from 8d. to 1s. per lb., maize will take its place as one of the most important crops in Victoria. From these remarks it must not be thought that maize-growing should be confined to the river and creek valleys mentioned above. We have abundant proof within the last few years that maize, with proper treatment and cultivation, can be profitably grown over a great part of Victoria.

Varieties to Grow.

After twenty years' trial I am of opinion that the best varieties, like those of export apples, are very few indeed. Those that have survived the test of time in Gippsland are the Early Leaming, Sibly, Ohio Goldmine, Early Eclipse, and Longfellow. The latter can be planted later than any maize I know, but is not a heavy yielder. Early Eclipse is the



MAIZE AND STOCK STATISTICS, 1904.

	VICTORIA.	IOWA.	ILLINOIS.
Acres under Maize ..	12,000	9,295,000	9,428,000
Yield	904,239 bus.	303,039,000 bus.	344,133,000 bus.
Average Yield per acre	76·6 „	32·2 „	36·5 „
Exports	198,452 „	63,638,000 „	154,860,000 „
Horses and Mules	376,548	1,188,000	1,359,000
Cattle ..	1,522,265	4,802,000	2,688,000
Sheep	8,774,731	705,000	698,000
Swine ..	315,333	7,290,000	3,740,000

best maize I am acquainted with for either ensilage or stover, being very tall and fine in the stem. Looking at the splendid result obtained from the introduction of new varieties from America, I agree with the Director that fresh importations should be made every year or two, especially from latitudes higher than Victoria, so that maize-growing may be extended to South Gippsland and the Western District. I would suggest that the Agricultural Department take up the question of stover. The Americans have increased the feeding value of their maize crop by 40 per cent. by this treatment, and if the Department will only take up this system of treating our maize crops as heartily as it has the ensilage question within the last three years, maize will shortly become one of the most important crops in the State.

MAIZE CULTURE.

There can be no question that one of the most important fields of agriculture, which as yet has only been touched upon in Victoria, is the cultivation of maize. Of all the annual crops maize stands unrivalled. Under suitable conditions the perennial lucerne produces a larger quantity of more valuable food products, and therefore it may be said to stand above maize, but of the ordinary crops which can be cultivated from year to year, there is nothing as yet discovered on the face of the earth which yields such satisfactory results as maize. In four or five months' time, under favorable conditions, from 15 to 40 tons of green fodder can be produced to the acre; while if grown for grain the yield may amount to anything up to 140 bushels to the acre. Henry, in his book on *Feeds and Feeding*, remarks:—"Were a reliable seedsman to advertise Indian corn by a new name, recounting only its actual merits while ingeniously concealing its identity, his words would either be discredited or he would have an unlimited number of purchasers for this seed-novelty at almost any figure he might name. The possibilities of American stock farms, in the live stock they may carry and the animal products they may turn off, are measured only by the quantity of corn and clover which the land will produce, and this, under good management, seems almost unlimited."

A glance at the sketch-map drawn to the same scale as Victoria will show the enormous extent to which maize is cultivated in the States situated within the "corn belt." It will be seen that in Illinois and Ohio nearly one-fourth of the total area of each State is annually sown to maize. Throughout the whole central, southern, and eastern States, maize either stands unrivalled as a grain crop or is second only in importance to wheat. The average yield in the United States over a series of years amounts to about 25 bushels per acre, while the maximum yield is an average of 40 bushels, and there are 10,000,000 acres sown to maize every year which yield only from 10 to 15 bushels to the acre, and are not expected to do more. But even under these circumstances, maize is looked upon as the most profitable crop which can be grown. A glance at the figures supplied with regard to live stock kept in the two great "Corn States" reveals at once the enormous amount of food which can thus be provided; and it will be noted that in the case of Iowa, very little of the crop is exported. In other words, nearly the whole of it is used to feed the cattle, horses, and pigs in the State. For purposes of comparison, it may be mentioned that the wheat yield of these two States only averages 17 bushels per acre.

In order to produce a successful crop, maize requires to be grown on rich land, and to be supplied regularly with water during the growing season. An equivalent of about nine inches of rainfall is required in order to produce a heavy crop; and the reason why maize sometimes turns out a failure in the moister parts of Victoria is simply owing to the fact that the rain does not come at the time when it is wanted. We will show, however, that by thoroughly preparing and working the land, a very large proportion of the necessary water should be conserved in the sub-soil, and rendered available for the use of the plant. Many people have the idea that maize requires a hot climate, but by referring to the sketch map it will be seen that the two greatest maize States in the world lie principally in the latitude of Tasmania; that while their conjoint area is one-fourth larger than Victoria, only a trifling amount of the territory lies in the same latitude as Melbourne, while none of it extends further north. The rainfall of these States is practically the same as that of the southern portions of Victoria. It is true that their soil is the rich black deposits of the prairies, but it is certain that the average soil is no richer than the average of the southern portions of Victoria. In the same way, while New South Wales and Queensland are the two chief maize-producing States in Australia, the average yield per acre is comparatively low, being about 25 bushels for New South Wales and 20 bushels for Queensland. In contrast to these facts, it may be said that the average returns from the river flats of eastern Gippsland are higher than those obtained from maize cultivation in any other part of the world under natural conditions of the soil. The yield for the whole of Gippsland averages, over a series of years, 60 bushels per acre, while well cultivated fields on the flats of the Snowy, Tambo, Nicholson, and Mitchell rivers frequently yield up to 140 bushels to the acre. The past summer has been one of the most unfavorable for the growth of maize in recent years, owing to the long dry spell in November, December, and January; yet, even under these circumstances, reports from the Ovens Valley show that a yield of 60 bushels will be obtained even in the northern parts of the State. Where properly planted and cultivated, satisfactory yields of both green fodder and corn are obtained in both the valleys and on the hills in eastern and southern Gippsland, and in isolated cases, similar results have been obtained in the neighbourhood of Melbourne. In the Western District, maize has hardly been taken up as a serious part of the year's operations, small plots sown broadcast for green fodder being all that has up to the present been attempted.

In the valleys of the Upper Murray and its numerous tributaries, returns equal to those just reported from the Ovens are regularly obtained, while all along the banks of the Murray, and, in fact, throughout the whole of the north of Victoria, good returns can be obtained by means of irrigation. Yet, strange to say, hardly a single acre of maize is grown throughout the whole of the principal Irrigation Trusts. So far, then, as the suitability of soil and climate is concerned, there are great possibilities for future development in almost all parts of Victoria. The fact which we have to demonstrate is that, under suitable conditions, maize gives a more profitable return per acre than any other annual crop. When once the farmer grasps this fact, it is certain that the cultivation of maize will be very rapidly extended.

Value of Maize as a Farm Crop.

The value of maize as a farm crop depends not only on the heavy tonnage of green fodder, or the number of bushels yielded per acre, but also on the fact that every portion of the plant produces most valuable food stuff; and it is a matter of indifference to the farmer whether he places his grain on the market or feeds it to his own live stock. As a general rule, better financial returns will be secured by the latter course. The fear that, with a largely increased production in Victoria, our export trade with the other States would be ruined, should therefore be groundless. We urge the cultivation of maize, not to increase the amount that we export, but simply to increase the number of cows, bullocks, and pigs that can be profitably raised on every farm. Should the price for the grain be remunerative, the grower may then place his produce on the market, but under average conditions a better price will be undoubtedly realized if the whole of the crop is turned into butter, beef, and pork. On the average, green fodder corn supplies about 1 per cent. of protein, and about 14 per cent. of sugar and fat, while the grain contains 8 per cent. of digestible protein, 67 of sugar, and 4½ of fat. These figures are rather lower in protein, but much higher in both the other constituents than is the case with either wheat or oats, so that when the total weight per acre is remembered, there can be no question about which is the most profitable crop. Another strong point in favour of maize is the fact that every portion of the crop may be utilized to fullest advantage, and various methods are available by means of which the full amount of profit may be realized from the crop. If it is decided to allow the crop to ripen for grain, the ripened cobs hang down, while the sheaf expands so as to form a kind of umbrella, which protects them from the rain. Once they are placed in the crib, no ordinary amount of rain beating on open sides will do the grain any harm, while the stalk itself may be utilized by means of the shredder or chaff-cutter either for dry fodder or for ensilage. Should the dairyman prefer to feed his crop to the cows, he may begin using it as soon as the cobs are fairly well developed, and continue to do so from week to week until the frosts set in. The most economical and, on the whole, most satisfactory method of all is to turn at least half of the crop into ensilage. In this case the grower is guided by the condition of the cobs. These are allowed to become two-thirds ripe before the crop is cut for the silo, and it should then be run through the shredder or the chaffcutter. Thus treated, a crop of maize makes the most palatable and satisfactory kind of ensilage that we are acquainted with. The fact that the stalks are solid secures the thorough exclusion of the air. The whole mass settles down so firm and solid that very little heating takes place, and the maize comes out of the silo but little altered from what it was when put in. Wide differences may be allowed in the amount of moisture in the crop with equally satisfactory results. On the other hand, wheat, oats, and other cereals all have hollow stems, so that even when they are chaffed it is difficult to get sufficient weight on the silage to squeeze out the air from the interstices. The extra amount of sugar present in maize is also a reason why it is so palatable to the cow; while the nutty flavour of the grain seems to be peculiarly acceptable to all classes of live stock.

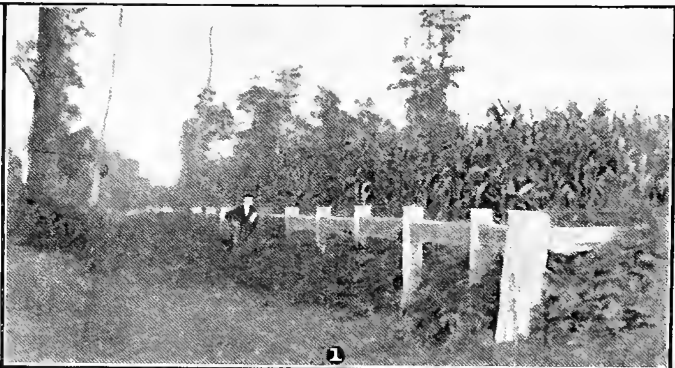
To put the possibilities of maize cultivation in a practical shape before our readers, it may be stated that a strip of land half a mile wide along each side of the Gippsland railways would represent £600,000 per annum, valuing the crop at 40 bushels to the acre, and the price at 1s. 6d. per bushel. The area would represent about 200,000 acres. Already broken patches of luxuriant crops are to be seen by the side of both lines, indicating how suitable even the hillsides are for the cultivation of maize, while away from the railways much more suitable land can even be found on the flats which mark the course of every creek and river. View 3 on the accompanying plate illustrates the adaptability of hill country for maize culture.

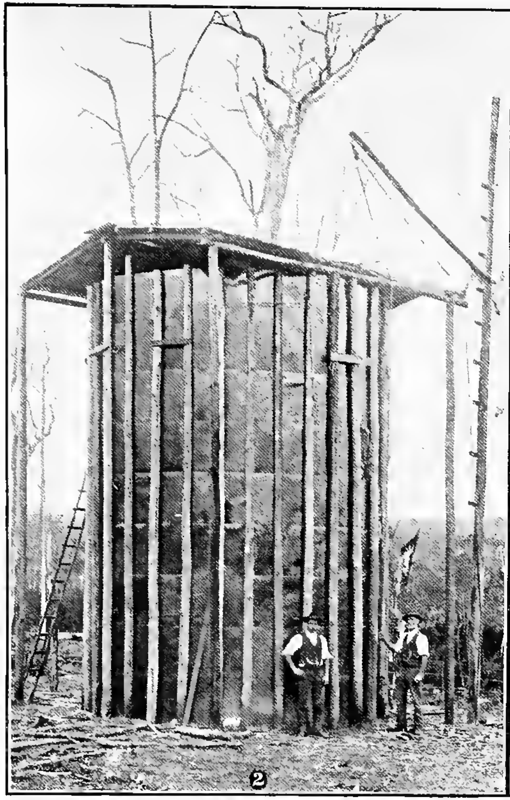
Growing the Crop.

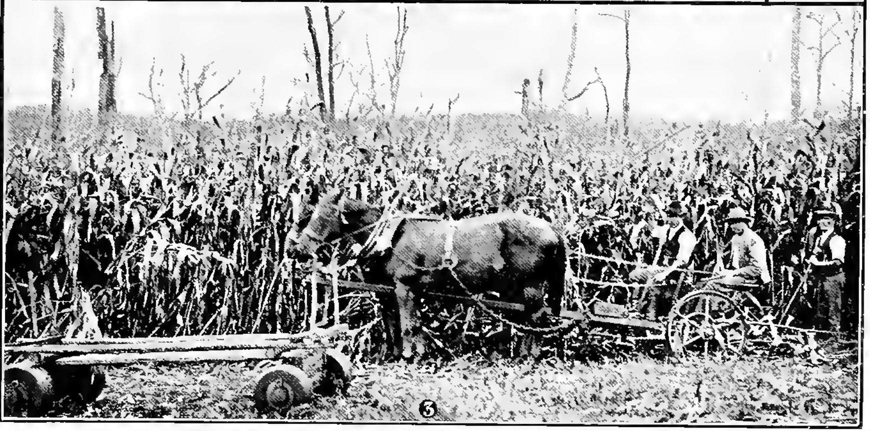
Unless the land is heavily manured, maize requires good, rich, friable loam. Its roots will extend 5 feet beneath the surface, so that the plant has great foraging power, and is able to use up all the available supplies of water. Poor land and land which is not thoroughly drained do not return profitable crops of maize. Poor land may be enriched to do so, but a water-logged soil is one of the things which maize cannot tolerate. It is essential for a satisfactory crop that growth takes place rapidly when once germination has begun. In a water-logged soil the drying of the surface takes place entirely by evaporation, and the mere fact of evaporation keeps the land very cold. Speaking generally, it may be said that it is much more profitable for a farmer to take in hand one or two acres of the land most favorably situated as far as the moisture is concerned, to manure this as heavily as possible with farmyard manure, and to trust to a heavy yield from a small area rather than the chance of a lighter yield from a much larger area. In all cases the land must be deeply worked. If possible, it should be brought to a fine tilth, but, provided other conditions are favorable, the maize can get along with a fair number of clods on the surface. If land is being newly prepared for the crop it should be ploughed in autumn, worked during the winter as often as it becomes dry enough to allow of this being done, and re-ploughed in October. Maize does best when it follows a leguminous crop, such as peas, beans, or clover sod, or it may follow the mixture of barley with peas or tares as recommended in Chapter III. On medium or inferior soils use 1 or 2 cwt. of superphosphate to the acre. The yield is so completely dominated by the water supply that it is difficult to give definite advice about the use of other fertilisers. American experience is that potash is next in importance to phosphoric acid, while a series of experiments carried out in 1903 by this Department seemed to indicate that potash is not required by our soils. On the other hand, nitrate of soda at the rates of 1 cwt. and 2 cwt. per acre, combined with 3 cwt. of superphosphate, produced a steady increase in the yield of green fodder from five experimental maize fields.

Time of Planting.

While the time of planting varies in different localities, the general rule to be aimed at is to have the young crop up as soon after the last frost as is practicable. Under average conditions, from the middle of October to the middle of November is the best time. Should the young crop be badly frost-bitten, the best plan is to scarify the paddock and to re-sow the whole of it. On the other hand, should planting be delayed until the end of November, the young plants may have to face a long dry summer while their roots are still comparatively short and delicate. A check at any period of growth is very prejudicial to the maize crop; and it may be safely said that no crop should be allowed to stand still for more than two or three weeks.







1 A Maize crop at Orbost. 2. Home-made Silo. 3. Maize Crop in hill country, Hospital Creek, E. Gippsland.

Method of Planting.

When maize is intended for grain, it is grown either in drills or check-rows. In the former case the rows should be one yard apart. The stalks in the row should average from nine to six to the yard. When a check-row planter is available, this method of growing the crop should always be adopted. These machines (Fig. 1) are so arranged as to drop three or four seeds at the intersection of every yard, so that the growing crop may be cultivated in two directions, and thus kept perfectly free from weeds. On the other hand, when maize is grown for green fodder, it is usually sown broadcast, and while this method may give a heavier total crop per acre, it is questionable whether there is anything like the same amount of nutriment per ton as there is when the maize is grown in rows. The stalks grow so close together that they are thin and spindly, and produce only a few poorly-developed cobs. A sufficient amount of sunlight is not received by the whole of the green leaves of the crop to complete the elaboration of the food materials, while there is the very great disadvantage that nothing can be done to conserve the moisture of the soil while the crop is growing. Most growers assert that as a set-off to these disadvantages the stems are so fine that cattle readily eat nearly the whole of them, while the big coarse stem produced by thinner planting is too tough for the cow or pig to consume. On the other hand, if the maize is made into ensilage, the rinds of the thickest stems are softened so as to be completely eaten and digested by the animal. The thick stem contains a larger weight of sugar, while the cobs contain more than one-third of the total nutriment in the crop. The advantages of ensilage, therefore, are easily seen. The crop may be planted close enough to produce the greatest possible amount of food-stuffs, both in the stalk and

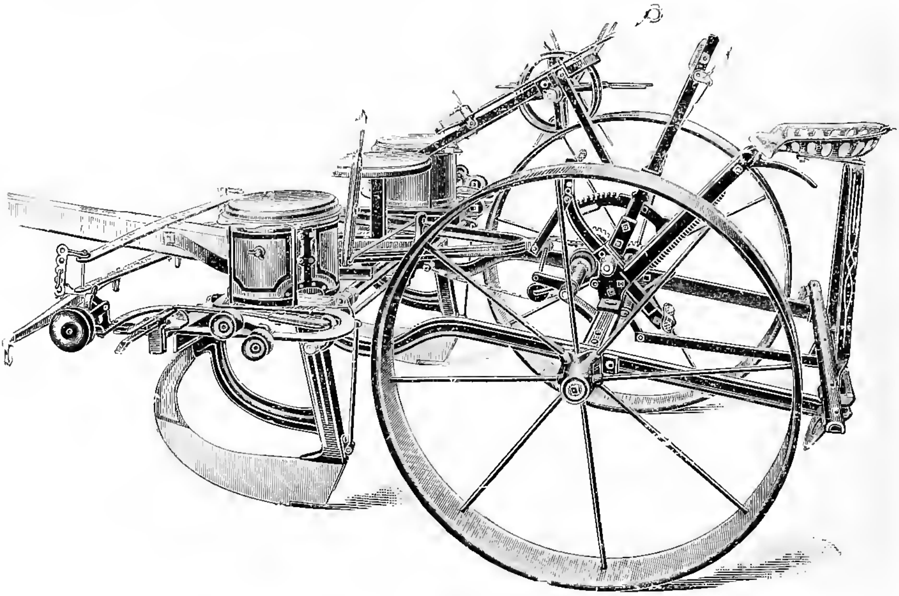


FIG. 1.

cobs; while, at the same time, should the grower change his mind, the crop may be allowed to stand over for grain only, while the land may be worked so as to conserve all the available moisture for the purposes of the crop. A long series of experiments in America proved conclusively that the greatest amount of food-stuff is produced when there are about four stalks to the square yard, or 18,000 to the acre. It will be seen, therefore, that we recommend the planting in drills a yard apart for whatever purpose the crop is intended. When a planter is used the seeds are buried about two inches below the surface. Where no planter is available the quickest plan is to open a light furrow and to scatter the seeds thinly along it by hand. A small hand-planter may be used to follow the plough along the same furrow. In districts where a long dry summer is the average condition, a deep furrow may be opened and the maize planted at the bottom of it. The seeds are lightly covered at first, and the trench is gradually filled in as the plants appear a few inches above the surface. We wish to repeat that no pains should be spared in the initial preparation of the land. Besides being deeply ploughed, it should, if possible, be subsoiled, and in any case it must be worked with a disc or other implement to a very fine tilth. When the planting is complete the whole field may be lightly harrowed. When sown broadcast it must in no case be sown on the ploughed ground, as is done in the case of wheat. Sow on the surface and plough in, and harrow frequently to keep in the moisture.

Subsequent Care of the Crop.

In the early stages of its existence, the little plant is in danger from the frost and the caterpillar. A single night's frost will ruin any crop in its early stages. It is the liability to frost which makes the growing of maize on many of the reclaimed swamps in Southern Victoria somewhat precarious. Where farms are of moderate size, much may be done by cooperation, in the direction of preventing frosts by means of smoke. If two or three farmers agree to grow their maize in close proximity, and keep small bundles of brushwood covered with damp leaves, straw, or manure, in readiness at distances of two or three chains apart, the frosts may be completely warded off. This is the method adopted with regard to all kinds of delicate and early crops in the best agricultural States in Europe and America. The fires are lighted as soon as the thermometer sinks to 34 degrees, provided there is no wind. The little fires go on smouldering for several hours, the volumes of smoke produced hang over the field in the still air, and it is found in practice that the slightest veil of smoke is sufficient to prevent the deposition of the dew, which is subsequently frozen into frost. In case, however, a crop is bitten, no time should be lost scarifying the ground and re-planting. As machine planters only take from half-a-gallon to half-a-bushel of seed per acre, the monetary loss other than that entailed in the labour is comparatively small.

Should the green caterpillar make its appearance on the crop while in the young stage, particularly if it is not growing rapidly, no effort should be spared to prevent its ravages. As these caterpillars travel from one field to another, they should be carefully watched for, and they may be almost entirely prevented from reaching the crop by the following device: —A plough furrow is run completely round the crop in such a way that the sod is turned away from the crop. There is then a sharp cut perpendicular wall 5 or 6 inches high, which the caterpillars have to surmount before they reach the crop. At any place where the coulter has not left a perfectly well defined wall the sides should be made perpendicular by means of a spade. At distances of 15 to 20 yards apart small square pits are dug with the spade at the bottom of the furrow. It is found that the caterpillars, instead of attempting to climb the perpendicular face, prefer regularly to travel along the bottom of the trench in the hope of finding a slope by which they are able to mount. As soon as they find the first pit they fall into it, and cannot easily get out again. Immense numbers are destroyed in this way, the caterpillars in the pits being pounded up with a square stick two or three times a day. Should the caterpillars obtain access to the crop when it has not grown 6 inches high, the most effective plan is to run a roller over the whole field; the young plants will be broken down and the caterpillars crushed, but no appreciable injury is done to the crop, as the plants very rapidly recover.

During the whole growing season it should be the aim of the farmer to keep the soil constantly stirred so as to conserve every particle of moisture that possibly can be rendered available for the crop. Any of the light cultivators or scarifiers are suitable for this purpose. Special ones, made for the maize crop, are arranged to work two of the rows at the same time, the machines being made to straddle the line of plants in the centre. Two inches deep is the best average depth to cultivate, but this must be regulated to a large extent by the condition of the surface. When a heavy rain has fallen the surface should be worked as soon as it will bear the weight of horses. It is the caking of the surface which we particularly wish to obviate, and in order that this may be effectively done it is most important to work the ground as early as possible after the rain. As the plants increase in height, a little of the soil may be turned towards the roots. As the maize not only sends its roots down deep, but is also to a great extent a surface feeder, it is necessary to be careful not to work the soil too deep, for fear of destroying a large percentage of the surface roots. When the crop is planted in check rows, the field is worked first in one direction and then at right angles, so that in this way every particle of the soil receives a proper amount of attention. The growth of weeds is injurious in two ways: they not only rob the soil of nutriment, but they also absorb a large amount of moisture which otherwise would be available for the maize. No definite directions can be given for the time which should elapse between successive workings of the surface. The condition of the ground is the most important guide. So long as it is clean and finely pulverized, there is no need to work it, but as soon as a shower of rain falls and the slightest crust is formed, this should be at once broken up. As long as horses are able to travel between the rows, the workings should be continued. It is found, both by experiment and by experience, that two or three inches of loose soil on the surface of any area form the most effective means which it is practicable to use to reduce evaporation to the least amount. Remember that cultivation not only kills the weeds but conserves the moisture and makes plant food available for the crop.

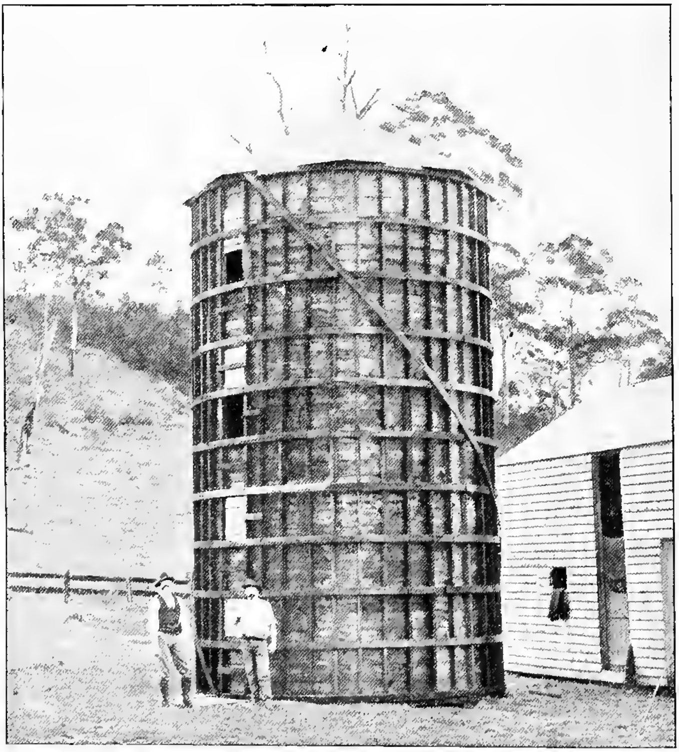
Disposal of the Crop.

As the crop is reaching the ripening stage, the farmer must make up his mind as to the use to which it will be put. If it be decided to use any part of it for ensilage, the right time to cut it is when the kernels have passed the milky stage and are beginning to glaze. It is found at this period the maize not only makes the best ensilage, but you secure the greatest weight of the crop and the greatest possible amount of nutriment. The degree of succulence of the stem is such that the whole mass of ensilage is able to absorb its own juice, while at the same time it does not become mouldy through being too dry. The grain is yellow or a light red in colour, and while a few of the lower leaves on the stalk may be withered, the amount of nutriment which is thus lost is very small, and the dry leaves serve to absorb some of the surplus moisture of the stem. As already stated, first-class ensilage can only be made when the material is chaffed or shredded, but in the absence of the necessary machinery fairly good maize ensilage may be made in the stack, although in this case there is considerable waste on the outside. The best plan is to excavate a round pit five or six feet deep and slab up the sides for the same distance, using the stuff which has been thrown out of the pit to strengthen the outside of the upper part of the wall. Provided the sides are kept fairly smooth, very good ensilage may be made in a pit 10 or 12 feet deep. As the successive bundles are carted in they should be deposited so that the heads and the butts fit into one another. The sheaves should be placed lengthwise against the wall, the reverse way to building a stack, and as the filling takes place every effort should be made to thoroughly consolidate the mass. There is no better plan than to lower a horse into the pit and keep him trampling on the material until the pit is full. As considerable shrinkage is certain to take place, the maize should be carried up three or four feet above the top of the wall, and after a day or two slabs, earth, or stones to the depth of 18 inches or 3 feet should be piled on the top, so as to put on as much pressure as possible. Full details with regard to the construction of silos for filling with chaffed ensilage may be found in Chapter XIII. It may be briefly said that by chaffing the material it is possible to exclude every particle of air, and by making the silos at least 20 feet in depth from top to bottom no extra pressure is required on the top, although, of course, if it is practicable to put any weight on the top of the silage the amount of loss will be thus further reduced. Maize silage is one of the best feeds for all classes of live stock; it is almost indispensable to the dairyman; it gives excellent returns for fattening cattle during the dry summer; it has been successfully used for sheep, particularly for ewes, both before and after lambing; and there is an increasing number of advocates for its use as a regular part of the dietary of the horse.

In harvesting the crop for grain it is usual to have the work of gathering the cobs carried out by piece-work, the usual price being 4d. per bag. The stems are bent down, the cobs twisted off, and thrown together in small heaps, and are then filled into ordinary corn sacks. As a general rule two full sacks of cobs produce one sack of shelled corn. The cobs are carted in to the farmstead and are then emptied into cribs. The cribs are constructed with a frame-work of saplings, the walls being made of wire-netting. They are usually 7 feet in width and of any length required. A rough flooring of slabs keeps the cobs off the damp ground, while the roof is made of bark, palings, or galvanized iron. The amount of rain which soaks into the cobs through the drift against the sides does no appreciable damage, while it is found that the air is able easily to pass through the thickness of 7 feet, and so bring about the complete drying of the crop. The cribs are often 15 or 18 feet in height, and many ingenious devices are seen to raise the sacks of cobs to the top and automatically empty them into the crib. For a small crop a small hand-sheller is used, but in maize districts shelling is done with a portable engine and plant in the same way as ordinary grain is threshed. In the old days, the usual plan was to spread the cobs in a layer one or two feet thick over the floor of a large barn, but experience shows that the crib gives equally good results with much less labour. Where a man wishes to secure a special price for seed of any good variety, it is worth while to cut off both ends of the cob and sell only the grain from the central zone. Early maturing varieties, which are also capable of resisting a long spell of dry weather, are what should be sought for. The extent to which such characters may be fixed by a process of selection opens up a profitable and useful field for observation on every maize farm.

MAIZE IN SOUTH GIPPSLAND.

"The land utilized for maize culture was ploughed in winter and harrowed whenever the weather was suitable, say, four times. Reploughing was done as near the middle of October as possible, and the soil harrowed down again. Drills, about 18 inches apart, were then run out with the shovel point of the horse hoe, and the maize, half bushel good seed, dribbled by hand after the machine, after which the land was again



A GIPPSLAND SILO.

harrowed and carefully rolled down. The plants were kept free from weeds until the crop was two feet high."

"The crops for the past three years have been good, the average yield per acre being 80 bushels, whilst the green feed has been from 8 to 13 feet in height. The conclusions I have arrived at concerning the varieties grown by me are as follow:—

"*Horse Tooth.*—Soft corn, requires no crushing. Broad flag, strong grower. Was sown on the flats and grew magnificently, the cobs being from four to five inches across the base in quite 60 per cent. of cases. Turned out excellently in silage and for green feed.

"*Selected White.*—A vigorous grower, with a strong tendency to give a good cob. Broad flag, strong stem. Good on river flats or on the hills. Has always been good for silage and green feed.

"*Early Red Hogan.*—Has a small cob, and is extra early. Is the best filler and the heaviest yielder. Will grow on medium soil. Is a good dry corn.

"*Selected Moruya.*—Is a good filler, fairly early and a heavy yielder. Broad flag, large cob, and is a strong grower. Requires a good soil. A beautiful coloured corn, excellent for market, also good for green feed.

"*Golden King.*—A tall, late variety; a strong grower, and the heaviest yielder for green feed. Grown on rich river lands."

—A. MOLLOY, (Tarwin).

CHAPTER XI.

TOBACCO.

CROP OF HEAVY TOBACCO, KING RIVER.

A comparative analysis of the soils from some of the chief tobacco producing districts of America with those of the north-eastern portion of Victoria tends to show that, so far as the land is concerned, there is no reason to doubt that good leaf should be produced here. The climate also, in many parts of this State, is very similar to that of the tobacco growing areas of the United States of America.

Soil and climate are the two chief factors required for the production of good tobacco; but a third, and equally important one, is knowledge and care in cultivation and curing of the leaf by the grower. The importance of a careful study of the different requirements of the crop does not appear to have been fully realized by tobacco farmers so far, and they have had little or no assistance from literature dealing with the subject, based on local experience.

The production of tobacco leaf is one of the highest forms of intense culture, and the haphazard system followed by many growers in the past can never result favorably, nor tend to keep pace with the progress of other countries. A better class of tobacco is smoked in Australasia to-day than was the case ten years ago, and the grower must recognise the fact that, unless he provides a closs of leaf equal to requirements, and sufficiently good to compete with imports from the outside world, he must rest satisfied with low prices.

A close study of the requirements of the different varieties and their respective treatments will save much time and loss, and lead to general improvement. That good leaf can be grown has been demonstrated by some of the more enlightened growers, and satisfactory profits have been made from the crop. But it has been found that in many cases growers have been using seed that has been grown in the same district for twenty years, and were even then not aware of the name of the variety. The tendency was to grow for size and weight, without regard to the type or quality likely to be produced from the soil. Seeing that there are more than one hundred known varieties of the tobacco plant, and that it is quite as necessary to plant certain varieties suited to the soil and climate to produce correct types, as it is with vines to produce certain wines, it will readily be realized that, by attention to these matters, a better leaf will be produced in many cases from soils that have been used hitherto. Again, better systems of cultivation, handling, and curing will have a marked effect upon the quality of the crop. Flavour, texture, colour, and burning qualities have all to be considered in the production of tobacco leaf, and these apply to all types of tobacco. Bright, heavy dark, and cigar tobaccoes require different soils and treatment, and with our great variety of soil and climate there is every reason to suppose that these different types will be grown. The greater the variety grown the better for the producer, as there is a wide market for all the types mentioned in Australia, and a practically unlimited one abroad, provided the leaf is up to the standard required.

The Department of Agriculture has, for some time past, conducted experiments at Edi and in various other parts of the north-eastern districts with a view to ascertaining the varieties suited to soil and type. Experiments have also been undertaken in curing, the treatment of diseases, and the different methods of handling the plant. A large quantity of seed has been acclimatised from specially selected varieties, the original stock being imported from America, for distribution amongst growers.

It is now proposed to give the benefit of the knowledge acquired to intending growers, and though the experiments have been limited to only one portion of Victoria, and may still be considered to be in their infancy, much has been deduced that will be of value to growers. General information as to the care of the crop, and other relevant matter, are dealt with also.

Climate and Soils.

Tobacco will grow in almost all climates, excepting the coldest. Where the climate is warm, and the rainfall regular, so that the plant will grow fast and without check, the texture of the leaf will be fine, and the quality good. If the rainfall be scanty the leaf will be thick, and the quality not so good. Very wet seasons have a detrimental effect on the quality, and cold climates never produce the best tobacco. Heavy dews during the ripening stage have a good influence on the leaf. Frost will injure the tobacco; therefore, it will be seen that a warm climate, with a regular rainfall during the growing season, is desirable. Tobacco is only from three to four months in reaching maturity after transplanting, and does not require heavy rains, but should have sufficient to keep it always growing. When grown near the sea, the burning qualities are, as a rule, bad, owing to the absorption of too much chlorine.

The tobacco plant thrives best in a good mellow, loamy soil, with a porous subsoil. A good percentage of sand is an advantage. Heavy, stiff, wet soils do not produce leaf of good quality. Rich, strong, black soils are also to be avoided, as tobaccoes produced from these lands are too coarse and rank. No soil containing a heavy percentage of chlorine will produce tobacco with good burning qualites.

Different types of tobacco require soils suited to their development. Dark soils, as a rule, produce dark leaf, while light-coloured soils suit bright tobacco. A freely-drained soil is essential for the production of good leaf in all cases. For yellow and bright tobaccoes a grey, sandy or slaty surface soil, with a porous, yellowish subsoil, is considered best in America. For dark, heavy tobacco, a deep rich chocolate, with a reddish subsoil; while for cigar tobacco, a deep, warm, sandy loam is required. Limestone country produces tobacco mostly used for chewing purposes. Cigar and light tobaccoes command the highest prices, but produce lighter crops than dark tobacco. All three types are smoked in Australasia. The popular taste, however, leans towards the bright aromatic description.

Varieties suited to types.

The difference in soil and climate in varied localities, especially in a comparatively untried country, makes it impossible to lay down any hard-and-fast rule as to the varieties to use. The safest and best course for the intending grower to pursue is to plant several of the improved kinds, with a view to ascertaining the most suitable. This plan is still followed in America, where new districts are cultivated, and when proved, the most satisfactory only is planted. Small plots of about 100 plants are sufficient for this test. Sufficient knowledge has been obtained from local experiments to enable us to choose from the host of varieties those most likely to succeed in certain soils, and the following results will serve as a guide, in some measure, to planters. In deep, rich soils, Lacks and Blue Pryor have thrived well. The former is a large plant, producing leaves 34 inches long by 20 inches wide; cures a light brown colour, with a smooth surface, and fine texture, and has been favorably commented upon by manufacturers. Lacks tobacco is sometimes known as Wand, and

HESTER TOBACCO.

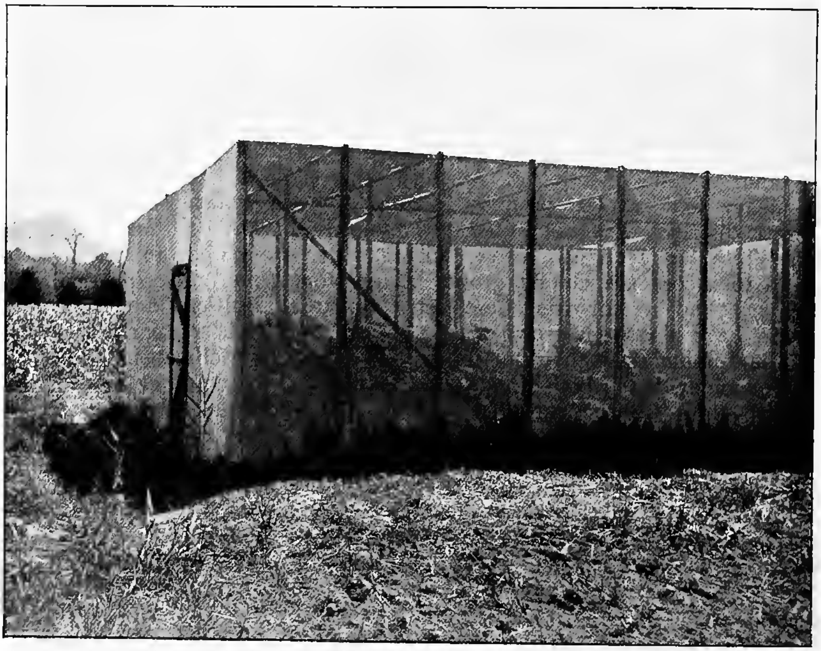
is one of the few varieties that will produce a heavy dark class of leaf when grown on strong soils, and yellow leaf on lighter soil. Blue Pryor grows a heavy crop, with a long leaf of a ruffled appearance, and has a sweet aroma. Both these varieties have had a thorough test on local soils, and are to be recommended. Blue Pryor is one of the original types, and is therefore less likely to lose its characteristics in new soils than the hybrid varieties.

On light, sandy soils Hester and Conqueror have shown the best results. Hester is a beautiful plant, with a heart-shaped leaf, and will cure bright on land that suits it. It is an easy tobacco to work, and will yield up to 1,500 lbs. to the acre. Conqueror is a tall grower, with the leaves well apart, and is one of the easiest varieties to handle. The leaf cures a reddish colour, with plenty of elasticity. Both Hester and Conqueror are early-maturing tobaccoes, a great advantage where frosts are to be feared. They can be planted 3 feet apart in the rows. On very light soils. Granville Yellow and Yellow Pryor have given fair returns, and cured well. They are apparently more subject to disease and insect pests than the other varieties mentioned. Amongst other plug varieties, Medley Pryor for heavy leaf shows promise. Hyco, though growing luxuriantly in several districts, has not cured satisfactorily in any, so far. Oronoco and White Burley have proved delicate, and very subject to insect pests. These tobaccoes are chiefly grown in limestone country in America, and have not had a fair trial here yet. Bonanza, Bullion, and Kentucky Yellow have also been grown for one season, but it is too early to give a definite opinion as to their suitability to our soils and climates.

For cigar leaf, both Comstock Spanish — sometimes called Zimmer Spanish—and Connecticut seed leaf have done remarkably well on the King River flats. They are both hardy growers, the Comstock Spanish especially. This variety is an easy one to handle. The leaves being long and pointed, do not droop, as is the case with most tobaccoes. It will yield up to 1,200 lbs. to the acre, and cures a nice light brown, with a fine elastic texture and a strong cigar aroma. It should be planted not more than 2 feet apart in the rows. The rows, however, are better 3 feet to 3 feet 6 inches, in order to get the texture of the leaf as fine as possible—a great essential in cigar leaf. The Connecticut seed leaf grows well, and is a heavy yielder. The leaves are close together on the stem, and droop heavily, with a good deal of frill round the butts. This makes it a difficult plant to sucker, and find the grubs on. When cured the leaf is fawn colour, rather dull in appearance, and, if planted wide on rich soils, is too coarse in texture. Other varieties, such as Havana, Sumatra, Vuelta Abago, and Cuban Havana have been grown, but have not succeeded well enough to be recommended, though it is quite possible that they may prove suitable in other localities.

Tent-Grown Cigar Leaf.

This practice of growing tobacco under cover is largely adopted in parts of America, where hundreds of acres are covered for the purpose. The yield averages 1,000 lbs. per acre, and prices range from 2s. to 16s. per lb. for the leaf. The structure is made 9 feet high, and covered on the top and sides with cheese-cloth. The frame can be built of poles 12 feet apart, with battens or galvanized wire stretched across the top to support the cloth. The cost is, approximately, £65 per acre; but this can be reduced considerably where timber is easily available, and the cheese-cloth bought in large quantities. The life of such a structure is from two to six years for the frame, according to the class of timber used, and for the cloth, two years. Cigar leaf has been grown at the Government Tobacco Farm, Edi, under these conditions for the past two years, with very encouraging results, the report on the first year's leaf, by a leading Melbourne cigar manufacturer, being as follows:—"They are the best samples of Australian cigar leaf we have ever had submitted to us, and we ourselves would be prepared to purchase immediately a large quantity of such leaf, at a price which we believe would be profitable to the producer, allowing for the extra cost of growing under cover."



CIGAR HOUSE AT EDI.

There are many advantages in this system of culture. The plants can be set earlier; they start better, being protected from the direct rays of a hot sun; they require less watering in dry seasons when planted; there is less evaporation, and the temperature is more regular. The plants are protected from frosts, insect pests, hail, and wind. The texture of the leaf is finer, the size larger than that grown in the open field, and the area to be worked for a proportionate return is much smaller.

Tobacco Seed.

Very great improvements have been made in America of recent years in the production of tobacco seed by selection and cross fertilization, and the character of the leaf grown from this seed, has been wonderfully improved. From these improved varieties a leaf of better texture, with a larger proportion of usable leaf as compared with the size of the mid-rib is obtained, the distances between the veins of the leaf are more even, and the leaf is more useful to the manufacturer.

No seed for a farm crop is so cheap, the average price being 5s. per ounce, and an ounce of good seed will provide sufficient seed for ten acres. All up-to-date farmers will realize the importance of using only the best seed available, and should purchase only from reliable sources. Seed of all the successful varieties grown at the Government Tobacco Farm has been acclimatised from imported seed, and small quantities can be obtained by intending growers on application. A change of seed is quite as necessary for the production of tobacco as it is for potatoes or any other crop.

Seed Beds.

A plentiful supply of plants, when the season for transplanting to the field arrives, is very necessary, and more than the actual number required should be grown. One ounce of tobacco seed is estimated to contain 30,000 good seeds, and this will plant about 100 square yards of beds—enough for 10 acres of plug tobacco.

In choosing a site for tobacco beds, take a good piece of soil, freely drained, and protected from the cold winds. New land is preferable. Beds near standing water, such as lagoons, have been noticed to contract the disease known as Blue Mould before any others in many cases. They can, however, be close to running water, and it is an advantage to be near a stream if the season is dry, and the plants require watering. To prepare the bed, the space required should be marked off, and the surface soil well burned by piling logs, brushwood, straw, or any other matter of a similar description, and burning them until the surface soil is thoroughly cooked to a depth of 2 inches. The fire should not be started while the soil is wet. As soon as the fire has burned out the large ashes should be raked off, leaving the smaller, as they will have a beneficial effect. The object in burning is to enrich the soil, and kill the seeds of vegetation, and thus save much weeding later on. Many growers raise plants successfully without burning, but it is a saving of trouble in the end, and the plants get the benefit of the potash from the burned material—a plant food particularly necessary to tobacco.

The most useful shape of the bed is 3 feet wide, and any convenient length. This width will allow for weeding and watering without stepping on the bed, and at pulling time the best plants can be selected without injury to others. Some level beds, and some raised, should be made to provide against a drought or a wet season. The depth the soil should be worked depends on the land, but the cold subsoil should not be turned up; from 4 inches to 7 inches is about the usual practice. The soil should be worked very fine, and the seed sown on the surface. It will be found necessary to mix the seed with dry sand, or sifted ashes, in order to distribute evenly. With a late sowing, a little bone-dust is a good thing. Sow up and down the bed two or three times, and the seed will be well scattered. Do not rake the seed in, but press the surface with a board or stamper, and cover afterwards with clean straw about half-an-inch thick, to protect from frost. This should be removed later by degrees, as the danger from frost passes. Another and better system is to enclose the bed with a frame of boards or logs to a height of 1 foot, and lay battens across from side to side 4 feet apart. On these, cheese-cloth is stretched, sewn together in 9-feet widths, and nailed to a batten at each end. This can be removed and replaced easily when required. The cost also is very little. The plants are protected in this way from frost, insects, hail, and wind; they grow quicker, but not so quickly as in a hot-house. Before transplanting the cover should be left off for a few hours during each day for a week, to harden the plants. Plants raised under glass are delicate, and have poor roots by comparison with those grown under cheesecloth, and cannot be recommended. Forcing plants in the North-Eastern District has proved dangerous, as they are more inclined to get disease. It may, however, be necessary in some seasons to grow plants quickly, and they can be developed very fast by making a hot-bed in the following way:—Dig a pit a foot deep, and into this put 6 inches of straw, then 6 inches of new stable manure, and top up with 6 inches of good soil. Sow the seed, and cover with hessian frame.

Sprouting tobacco seed is sometimes done, but little time is gained, and failure often ensues. If, however, it is desired to try the experiment, it can be sprouted by putting some decayed vegetable mould in some flannel, and sprinkling the seed on the mould; then moisten with warm water. The flannel should be rolled up and kept in a warm place, and watered every second day. In six days white specks will be noticeable on the seed. It must be sown at once, or it will fail. The beds should be kept moist, but too much water is bad, and plants should never be watered when mould is prevalent. A light watering after seeding is a good practice.

Weeds must be kept down, and the plants should not be allowed to grow too thickly in the beds. It is wise to have beds in different situations and aspects. To hasten plants, if necessary, sprinkle the beds when the plants are dry with finely powdered stable manure. Another plan is to mix a double handful of nitrate of soda with 40 gallons of water, and apply to the beds with a light rose. The time to seed beds is very early spring, say, from July to October. It is also wise to make three sowings, at intervals of three weeks, in separate beds. If slugs attack the young plants, a dressing of finely powdered dry tobacco leaf on the beds will prove effective. If chemical fertilizers are used, they should be applied before seeding. A light dressing of superphosphate will give plants a start. If the beds have been burned, do not put on potash manures.

Preparation of the Field.

The deeper the soil is worked the better for the tobacco plant, as the roots will penetrate to a depth of 15 inches if the soil is open. Drought will not affect the crops so badly if the land is well worked, and better yields will result. Subsoiling has rarely been resorted to in Victoria, but there can be no hesitation in advising such a course for tobacco. Land suitable for the crop is of a light, friable nature, and is consequently easily worked. The area required for a tobacco crop in proportion to the return, as compared with wheat, oats, maize, &c., is about one-sixth, therefore the preparation of the soil is not a large undertaking, and will repay some extra trouble.

The first ploughing should be made late in the autumn, or early winter months, and should be as deep as possible, provided the land will stand deep cultivation. It should be well harrowed, and, if weeds make an appearance, the scarifier or other implements should be used to check them. Just before planting, the land should be ploughed about 6 inches deep, and worked to a very fine tilth. Rolling is often advisable. The finer the soil is worked the less labour will be required later, and the better the plants will thrive; and the quicker tobacco is grown the better will be the quality. It is not wise to prepare the field too far in advance of the planting; one or two days ahead is best.

In America the system of ridging is largely followed—that is, of marking out the field into squares by throwing two plough furrows back to back every 3 feet, or any other distance required, across the field from all four sides. This leaves a hill at the intersection of each row of furrows. In this the plant is placed. This system has proved inadvisable in Victoria, as, given a long period of drought, the plant does not thrive well. Level planting is the best in our climate. If the soil is not in first-rate order to a depth of 5 inches, it will be necessary to send a man ahead of the planter with a hoe, to chop up the spot in which the plant is to be placed. The rows are made by stretching a line across the field, and the distances are marked on this line by tying a piece of flannel 2 inches long at intervals of 3 feet. Care should be taken to keep the rows straight each way, to allow for cultivation later on.

Transplanting.

When the plants in the bed have grown leaves from 2 to 3 inches long, they are ready to transplant. If the soil in the bed is stiff, and the roots break in drawing, the bed should be watered a short time before pulling commences. An old dinner fork, to loosen the soil close to the roots of the plant to be drawn, is useful. The plant should be taken by the leaves, being careful not to bruise the heart or stem, and drawn gently. As each one is taken from the bed it should be kept in the left hand, with the roots all one way, and the handful then placed in a basket or kerosene-tin bucket, with the leaves to the outside and the roots to the centre. The plants, when pulled, should not be left exposed to wind or sun; a kerosene tin will hold from 700 to 1,000 plants, according to their size. When sufficient have been drawn, they should be covered with a wet cloth or green grass, and kept in a cool place until they are planted. Plants should always be pulled the same day as they are to be put in the field. A cloudy day, with the soil in moist condition, is best for transplanting, and, if such conditions obtain, it is wise to get as many out as possible. If dry weather continues, plant out in the evening. The rows are better north and south, to allow the sun access to both sides during the day. The planter should take the plant in the left hand, and, with the leaves closed together at the top so as to cover the heart, then with the right hand, or a dibble, make a hole about 4 inches deep, pulling the hand or dibble towards him, the roots are inserted, care being taken to keep them straight, and the soil pressed close round, so as to keep the leaves still protecting the heart. The first rain will settle the soil and leave the heart clear. If the tap root is more than 4 inches long, it should be nipped off before planting. When the soil is dry, it will be necessary to water the plant when put out, and the simplest way to accomplish this is to put a barrel in a cart or sled, and draw the water to the plot, when buckets can be filled along the rows. A boy can then water the plant from these with a small tin fixed on a handle about 3 feet long. A pint of water to each plant is sufficient, and this should be gently administered round the plant, not over it. If the sun is very hot, each plant should be covered with a few straws or fern branches, which can be removed when the plant has become established. Machines are used for planting in America. They are manipulated by a man and two boys, and water the plant when set, also distribute a fertilizer, and will plant from 3 to 6 acres in one day. It is possible in some localities to transplant too early. Tobacco that matures before the end of the summer is liable to miss the night dews, which have a most beneficial effect on the leaf during the ripening stage. On the other hand, if planted late, frosts may do some damage before the crop is harvested. In the North-Eastern District the best time to transplant is from the third week in October to the end of November. Plants are often set right into January, but the risk from frost is great, and if the plant is cut before fully ripe, both quality and weight will be affected. It is always wise to put on all the hands available at the right time, and it will be found that the work can be more economically done with four or five hands than with two, where a field of 10 acres has to be set.

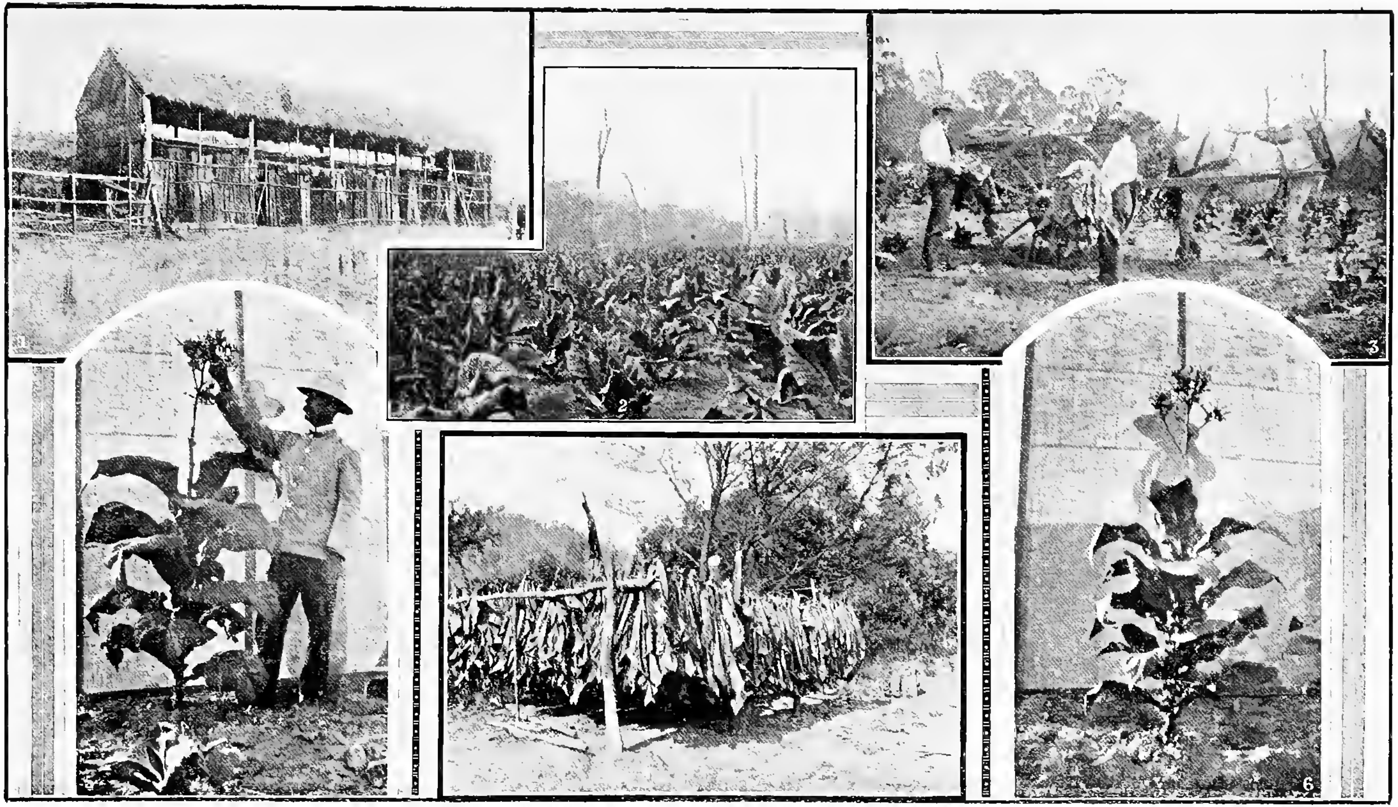
In a good season there will be a few misses, and these should be replaced as soon as it is ascertained that a plant has died. Plants with crooked stems should be avoided, also those with a bulb just above the root, and if the heart has been injured, do not set unless short of plants.

The distances plants should be set depends on the soil, and the variety used. On rich flats, for heavy tobaccoes, 3 feet 6 inches each way is usual. For bright tobaccoes, on light soil, 3 feet each way; and for cigar, 3 feet to 3 feet 6 inches apart for the rows, and from 18 inches to 3 feet in the row.

As soon as the plants have made sufficient growth to enable them to be seen throughout the rows, the horse-hoe or scuffler should be run through to stir the soil and prevent weeds from coming. This treatment should be repeated three or four times, as the season demands, until the plants are too large to admit of their being worked between. The later workings should be shallow, to avoid injury to the roots.

In the early stages of growth the cut worm sometimes does considerable damage by eating through the stem of the plant just above the roots. If this pest is bad, it must be watched for and destroyed. A good poison for the purpose is made by steeping bran in molasses and arsenic, or Paris green, and spreading where the worm is bad. If the soil has been well worked through the winter, this worm will not do much damage. The tobacco caterpillar also does a great deal of harm in some seasons by eating holes in the leaves and heart, and should be killed whenever observed. They will often drop to the ground when being searched for, and in hot weather are generally found under the leaf.

To keep the plants growing, the soil close round the stem of the plant should be kept open with the hoe, especially soils that cake round the stem. Later on, when the plant has reached a foot in height, a little soil can be drawn up to the stem all round by the hoe, to support the plant in case of windstorms. The advantage of priming, that is, taking off the bottom leaves to the number of five or six, is doubtful; they are of little value in themselves, but serve in some cases to protect the leaves above them from becoming dirty by contact with the ground, and also in exceptionally dry seasons prevent the sun from scorching the soil close to the butt of the plant. If it is done in this climate at all a light priming, say, three to four leaves, will be found enough. The field must be kept clear of weeds throughout.



1. Old style of shed.
4. Heavy Tobacco on scaffoldlin the field.

2. Tobacco-field, Hester and Conqueror.
5. Hester seed plant.

3. Loading Tobacco in the field.
6. Havanna seed plant.

Topping.

The flower bud should make its appearance about ten weeks after planting in the field, and should be taken out of all plants not intended for seed directly it shows above the top of the plant. When topping, judgment is required as to the number of leaves to be left on the plant. On rich soils, such as are generally cultivated in Victoria, a greater number can be left on than is customary in America. Our leaf is, as a rule, too rank and coarse, with too large a mid-rib, and strong flavour. For this reason it is better to have more leaves of finer texture and quality, and it has been found that sixteen to eighteen leaves are not too many to mature properly where the soil is rich. If the plant is left to nature, it will grow from 25 to 30 leaves, and it will be noticed that four of the bottom leaves and four to six of the top leaves are of inferior quality. Therefore, in topping, the inferior leaves should be removed with the bud from the upper portion, and not more than eighteen left on, exclusive of the four inferior bottom leaves. If the crop is late, and frost is feared, then it is better to top lower, and the plant will mature quicker. In extreme cases only four leaves are left on the plant, in order to secure them in time for a cure. Tobacco should all be brought as nearly as possible to the ripening stage about the same time. On poorer soils fewer leaves should be left on the plant, which otherwise might not have sufficient strength to mature properly. In pinching out the bud care must be taken not to injure the leaves left on the plant.

After topping nature asserts herself, and in the effort for reproduction the plant sends out suckers at the intersection of the leaf with the stem. These, if left, will produce seed, and they should be taken off, by breaking sideways close to the stem, before they are 3 inches long. This work will have to be done about three times between the time of topping and harvesting, and is absolutely essential, for if the plants are allowed to seed the leaf is never as good quality, and the weight also is much less.

Harvesting.

Generally speaking, the tobacco plant is ready to cut about eight weeks after topping, sometimes longer, as the season affects it. The leaf when ripe becomes granulated, with mottled spots of a lighter colour showing. If doubled between the fingers it will crack. It is very necessary to have tobacco thoroughly ripe when harvesting, and it is better to err on the side of over-ripeness than to cut green. Under-ripe tobacco will never cure well, nor have as good colour or flavour as properly matured leaf. It should be cut just before the leaf commences to waste, and a little experience is required to tell exactly when that is. Tobacco will sometimes show little brown spots on the leaf before it is ripe. These are due to sun blisters, and are not a sign of ripeness. At the same time, when the leaf gets over-ripe, similar spots appear, and are a sign the leaf is wasting. In the former case, the plant should be given more time, as generally only the top leaves are affected, and the plant will benefit greatly by being allowed to mature. The cutting of the plant is a simple operation, and is done with a knife made for the purpose, with a triangular-shaped blade about 3 inches wide, the point of the blade being let into a handle a foot long, with a cross-piece on the top. A butcher's knife is also sometimes used, and even a small hatchet will do in an emergency. The operator takes the top of the plant with the left hand, and splits the stalk with the knife to within 6 inches of the ground, taking care not to sever any leaves in the process. The leaves grow at right angles, so this can easily be done. The plant is then laid on the ground with the butt to the sun, when it will wilt after a short time, and be easily handled without breaking. Care must be taken not to allow the tobacco to scorch by too long exposure to the sun. As soon as it has wilted sufficiently to handle, the plants can be put in piles of five or six, keeping the butts all together, and turning the reverse side to that previously exposed upwards. These piles can then be carted or carried to the shed or scaffold to be hung up.

Tobacco should not be cut directly after rain, or with the dew on. Rain washes the gum out, and a day or two of fine weather will fetch it back again. If cut with the dew on it will break, and become very dirty. Tobacco should always be cut the day it is to be carted to the shed or scaffold, and on cloudy days it will take longer to wilt, so due allowance must be made.

Bright tobaccoes are generally taken straight to the shed. Heavy tobaccoes are scaffolded in the field for a few days before taking to the shed. Cigar tobacco is harvested without splitting the stalk, but is simply cut off close to the ground, wilted, and tied on to sticks and taken directly to the shed. All tobaccoes are hung on sticks 4 feet long, and about an inch diameter.

Curing.

This is without doubt the most important matter in connexion with the production of good leaf, and it is here that growers have much to learn with regard to making the best of the leaf grown. The mere drying out of tobacco is not curing. The latter is a much more complex process.

Tobacco leaf undergoes certain chemical changes during the curing process due to the action of ferments which are contained in the leaf cell, or protoplasm of the leaf cell. If the life of the leaf is killed by being frozen, or scorched by too great heat, a cure of that part of the leaf affected cannot be obtained, neither will the later process of fermentation take place. These ferments are called enzymes, and unless the conditions necessary to enable them to perform their work are present, a perfect cure is not possible. The aroma of tobacco is lost without a proper cure, and the flavour also is left undeveloped to a larger extent.

A too rapid drying destroys the enzyme. Cold and wet also have the same effect. Therefore it will be observed that the curing process should be gradual, and calculated to encourage the development of this active agent in the cure, temperatures between 50 deg. F. and 150 deg. F. are the most favorable. In some tobaccoes where colour for wrappers, and other qualities besides those of aroma are required, this enzyme is not fostered to so great a degree, but is still necessary for the fermentation process. Yellow leaf is an instance. Plug and cigar tobaccoes are, however, very dependent on the development of this agent, which will rid these tobaccoes of the strong bitter flavour and bad aroma they would otherwise possess, and improve the colour, texture, and smoking qualities of the leaf.

Different types of tobacco require different treatments, and the same tobaccoes will require a modification of the rules laid down for each type, according to the state of the tobacco when harvested. For instance, tobacco harvested in a wet season will contain more sap than that harvested in a dry, and will take longer to cure. Therefore, the grower must use his own judgment as to the process to be employed in any particular season, and must carefully watch the effect of his treatment on a certain portion of the tobacco undergoing the cure in the shed, and be guided by that. He should remember that too fast curing is much more risky than slow. Fast curing will be liable to fix the green colour in the leaf, and destroy the flavour.

Bright yellow tobaccoes are taken straight from the field to the shed in America, and the plants hung on the sticks at the rate of eight or ten to the stick. These are placed on the tiers 7 or 10 inches apart, and the fires immediately put under.

The following formula laid down by Mr. R. Ragland, of Virginia, America, is the basis of all subsequent treatments for bright tobaccoes. The heat is supplied by flues or charcoal fires, and is applied as follows:—

1. The yellowing process requires at 90 deg. F. from twenty-four to thirty hours.

2. Fixing the colour beginning at 100 deg. F. to 120 deg. F. over sixteen to twenty hours.

3. The curing process 120 deg. F. to 125 deg. F. over forty-eight hours.

4. Curing the stem 125 deg. F. to 175 deg. F. over nine or ten hours, increased at the rate of 5 deg. F. per hour.

Between each heating process the tobacco is allowed to cool down, and absorb moisture by opening the shed to the night air. The same treatment has been applied to tobacco in the North-east, excepting that the tobacco was scaffolded for five days, with success. Our tobacco does not appear to yellow in the field, as is the case in parts of America, and this is due probably to the use here of only the richest soils, whereas in America only light soils are used for bright types. Should the leaf while curing show moist brown spots close to the mid-rib, indicative of decay, the shed should be well ventilated, or a temperature of 110 deg. F. will stop the progress of the disease. This temperature will have to be raised by the use of fires.

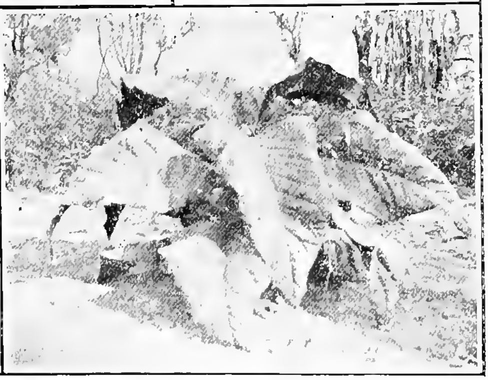
The system in vogue in America for curing heavy dark tobacco, is to scaffold for five or six days, then as soon as the shed is filled, to put fires under it. The heat should not exceed 90 deg. F. for twelve hours. After that it is taken up to 150 deg. F. by a gradual process. The leaf and half the stem should be cured in three days and nights. Then the tobacco should be allowed to become soft by absorption of moist air, and again dried out by fire. After this the tobacco should never be allowed to get very damp; but should have slow fires put under in wet weather.

In Victoria the system for curing heavy dark leaf has been very much that of Kentucky for chewing tobacco, that is chiefly air curing. If the weather is very dry, the shed is closed during the day, and opened at night. Small fires are put under in wet weather, and a current of air caused. A most reprehensible practice amongst local growers is the burning of the stalk while stripping the leaf, which is much damaged in aroma and flavour thereby. Only clean burning woods should be used in open fires for heating the sheds. The pits in which the fires are made should be at least 2 feet deep and 4 feet long, and be covered with sheet iron to prevent danger of fire. Stoves and flues would be a great improvement on the open fire. Many good crops of leaf have been spoilt in the shed through want of fires after the cure has been effected. The tobacco has been allowed to become too damp, and the lower half of the leaf covered with mildew. This deteriorates the quality and spoils the reputation of our leaf, as every year large quantities of such tobaccoes are put on the market. Tobacco is a great absorbent, and will become moist, and dry out again with every change in the weather, unless the conditions of the atmosphere are regulated by fires in the shed.

A very large proportion—90 per cent.—of the heavy dark tobacco crop is cured in America by open fires. In our climate a gradual process is necessary, owing to the dryness of the atmosphere, and the fires should not be put under too soon, or be too strong in the early stages, or the colour will be green, and the elasticity of the leaf be destroyed. Care should of course be taken against the risk of fire, and the lower tier of tobacco should be well above the ground, say 9 feet to the tier poles. Water should never touch tobacco from the time it is harvested till it is in the manufacturers' hands. Cigar tobacco is cured solely by the regulation of air and moisture, and the shed must be specially constructed for the purpose, so that it can be made very close, or be thoroughly ventilated at will. In some instances stoves with a pipe running up through the roof are used in our moist seasons, with the object of creating a current of air. The lower ventilators are opened at such times, the moist warm air being driven up and out at the top of the shed. Cigar leaf should not be allowed to get very dry, nor very moist, right through the process, which is a slow one, and requires constant observation. The shed should be kept dark after the leaf is cured, as light has a bad effect on the colour. The curing process will take from two to four months.

Stripping and Classing.

This work is usually done during wet weather, when out-door work is not practicable. After the tobacco has been thoroughly cured, and the leaf has become pliant enough to be handled without breaking, stripping can be commenced. The stalk is taken in the left hand, and the leaves pulled off with the right, taking hold of the leaf close to the butt. The bottom leaves are of inferior character, and should be classed as thirds, also all leaves that are badly worm-eaten or of bad colour. Generally speaking, the topmost leaves also are inferior to the middle, and these should be put into the second or third class, together with any damaged or bad leaves off the middle. The best leaves should be classed as firsts, keeping the long leaves all together, and the shorter likewise. The colours should be kept as evenly as possible together. Texture, colour, size, and soundness should all be taken into consideration. As the leaves are classed they should be tied in hands, or bundles, containing about ten or twelve of the same class or grade, the tie consisting of one of the smaller leaves; the butts should be kept even, and the tie lapped round as close to the end of the butt as can be done safely, extending down to a depth of not more than



7. Sumatra.
8. Hester and Comstock Spanish.
9. Hyco.
10. Comstock Spanish.
11. Conqueror.
12. Oronoco, topped.

2 inches. The loose end is tucked in between the leaves, and the hand rehung on the sticks and put up on the tier poles again. These hands can be put close together on the stick, about ten or twelve being the usual number. The general practice with local growers is to make only two grades or classes, but this is a mistake, and three are quite few enough. In America, as many as twelve are made in some tobaccoes. It is true that this is generally done by the dealer; but as we have no middleman buying and re-assorting tobacco in Victoria, it is the more necessary for the grower to give attention to this particular point. Another mistake has been the making of too large a hand, often four times larger than it should be. Very large hands take longer to tie, and cannot be made as neatly as smaller ones. They are more liable to come loose, and when sampled, after pressing, do not show well, owing to the leaf having pressed flat, while the butts look too large in proportion. The buyer immediately concludes that there is too much mid-rib in comparison with the usable portion of the leaf. The tie also has to be made deeper to hold the larger number of leaves, and this makes the leaf look shorter. The better the appearance of the leaf, the more money it will sell for. It is a good habit to bulk down sufficient tobacco on the sticks, if it is thoroughly cured, to provide stripping for several days. Where the grower has had some experience, the whole crop can be put down for this purpose, but should be re-hung as stripped until bulked for the sweat or fermentation process. The assistance of children can be availed of for stripping, as the work is light and pleasant.

Bulking down for the Sweating Process.

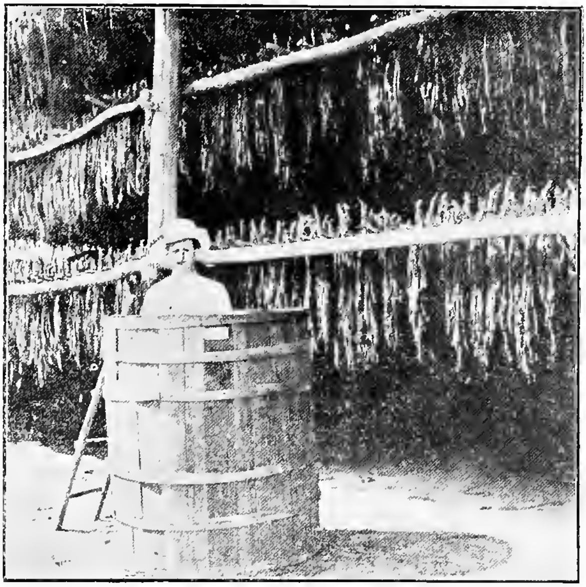
After the tobacco has been thoroughly cured, stripped, and classed, and re-hung in the shed, it should be kept in sweet condition until the spring, by the use of fires or ventilation, and the shed kept darkened. A platform should be made about 1 or 2 feet from the ground, on trestles or logs, the floor of the platform being made of boards or hang-sticks; if the latter, clean straw or bags should be placed on top. Bulking down should never be done while the leaf is so dry that it will crumble, neither should it be put down when the tobacco is so full of moisture that it will mould. The right condition is when the mid-rib will crack two-thirds of the way up the leaf, and if the leaves are squeezed together in the hand they will open of their own volition when released. It is never wise to put tobacco down until the first warm weather in spring. Tobacco can be put down in cold weather, with a large amount of moisture content, and will be safe until the warm weather ensues, when it is liable to mould, and will not sweat properly. The proper season is when the tobacco is coming into condition with the first warm moist weather, that is, after the tobacco has been dry, and is becoming sufficiently moist to handle without breaking, and will stand the tests previously described. It will then go through a mild sweat or ferment, and in three to four weeks' time will open up greatly improved in quality and aroma. Much tobacco has been ruined by non-observance of this practice. If the tobacco is bulked down when the moisture is drying out, after a wet spell, the sweat will not be satisfactory, and unless it has experienced some warm weather, will not be safe to pack, as it will go mouldy in the bale or cask. Having got the tobacco in good condition, and a suitable season for bulking down, the tobacco should be taken from the tiers and packed upon the platform, keeping all the butts to the outside. It should be kept as straight as possible, and can be piled to a height of 5 feet. It can be piled while still on the stick, or can be taken off and packed by itself. One fairly large bulk is better than two small ones. The best leaf should be put in the centre of the bulk, with the second grade at the bottom, and the third on the top. When finished, the whole pile should be covered with old tarpaulins, hessian, or any old cloths, over top and sides. The bulk should be examined every few days to see if heat generates, and directly the temperature rises above 80° F., the whole should be turned. The insertion of the hand well into the bulk will indicate whether there is a rise in temperature, but a thermometer placed in the centre of the bulk, with a cord attached, will be a more reliable guide. Tobacco, if put down in the right condition, does not always require turning, but will go through a mild sweat, and, properly speaking, should never be packed for market until it has gone through a spell of moist warm weather. Three to four weeks is the usual period allowed for the sweat, but if the weather continues cold after bulking it should be left longer, and once it has gone through the sweat it can, if required, be left for months in bulk, and will continue to improve. It should, however, be in a dry situation and be kept dark.

The fermenting of cigar leaf is a much more scientific process, and should be done in this State by the manufacturer, as the grower has not at his command the necessary heating rooms and steaming apparatus required. The leaf can be much altered in character, according to the degree of fermentation employed, and it has recently been ascertained that some cigar tobaccoes are improved by being taken to 170° F. during the process. This can only be accomplished by skilled hands. One of the cigar manufacturers in Melbourne (The States Tobacco Company) has offered to take good leaf, directly after it has been cured, to put it through the fermentation stage in the factory to test its qualities. This will be a great assistance to the grower until he is able to undertake this important work himself.

The fermentation of tobacco is partly a chemical, and partly a life process, during which there is a slight loss of weight. The starch in the leaf is turned to sugar, which is consumed during the process of fermentation. The percentage of nicotine is reduced, and the tannin almost all taken out. Thus the flavour is modified by the loss of nicotine, and the raw bitterness caused by the tannin removed. The aroma and burn of the tobacco are also greatly improved.

Packing for Market.

The old system followed by the grower of packing tobacco in bales, enclosed in hessian and tied with hay-band, is not a good one, more especially where the tobacco has to travel long distances by road and rail. Tobacco so packed is very often much damaged by wet in rainy weather. In dry weather the leaf becomes brittle, and is badly broken by handling, rubbing, and cut by the tie-ropes. There is much waste in consequence, and the bales often reach their destination in a misshapen and uninviting condition. The loss in weight is often considerable. The leading growers now pack in casks, which can be obtained from the manufacturers at 5s. each. These casks are 4ft. 8in. high, and 3ft. 6in. in diameter, and will hold from 1,000 lbs. to 1,200 lbs. of heavy tobacco, and from 600 lbs. to 800 lbs. of bright leaf. The screw press is the most convenient, but a lever press can be made effective. The method of packing in the cask is for one man to get inside the cask, first removing his boots; the hands are then given to him, and are placed across the middle of the cask, in two rows, the butts being kept all one way, and the hands kept as nearly as can be in the shape of a cylinder; then the hands are packed all round the cask, keeping the butts close up to the inside staves. The next layer is put in the same way, except that the cross-rows should have the butts the reverse way. The layers should be kept an even thickness, with the middle always well filled. When the top is reached, the false lid is put on and the tobacco pressed down to about one-third of the height of the cask. Four fillings will suffice, and the lid is used for the last pressing, and is fixed by nailing hoops inside the cask, round the top.



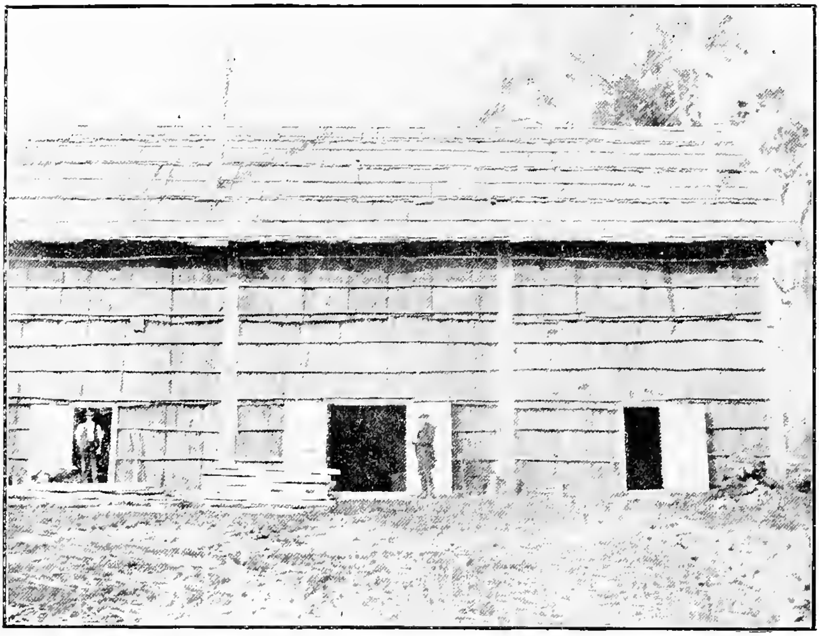
TOBACCO CASK AND TOBACCO HANGING IN OLD-FASHIONED SHED.

The different grades should be kept separate, and each cask carefully marked with the weight of the empty cask, as well as the weight of the tobacco, and the grade—it is also wise to number each cask, in the event of one going astray, to enable it to be identified, together with the owner's brand. The advantages of packing tobacco in the cask are obvious. There is less danger from wet, no loss in dry weather from breakage, and the cost of the cask is not more than that of hessian, as five bales of tobacco will be contained in one cask. The tobacco also improves in the larger bulk. Heavy dark tobacco will stand more pressure than bright, therefore less of the latter is usually packed in each cask. Cigar leaf is packed in boxes containing from 300 lbs. to 400 lbs., but if sent to the manufacturer before fermented should be packed loosely and delivered with all possible haste, as if delayed for several days there will be danger of heating, especially in warm weather.

Sheds for Curing.

The site for a tobacco shed should be chosen with a view to getting the advantage of the prevailing winds, when required. At the same time, a very exposed position it not desirable. A wet floor is to be avoided, and as tobacco sheds are not, as a rule, boarded, a dry site is essential. It is often possible to choose a site on the edge of a bank, which will prove convenient for cutting out for a furnace, or for making such an excavation as will allow a waggon to be backed in to save lifting in loading, &c.

For curing different types of tobacco differently constructed sheds will be necessary. For curing bright leaf the shed should be small, as it is easier to get the tobacco all in the same condition in small quantities, and also to regulate the heat for the curing process. A square shed, 16 feet x 16 feet, four tiers or floors high, will hold an acre of tobacco. The lowest tier should be 9 feet from the ground, having poles 4 inches in diameter, running from end to end. These should be 4 feet apart on each floor. On these the sticks carrying the tobacco are hung. The next tier should be 3ft. 6in. above the first, and the third the same distance above the second. Two rows can also be hung in the roof. The walls should be made close, with ventilators to open or shut round the bottom, and the roof should also be well ventilated to allow the moist air to be driven out freely. The whole building is best constructed of wood.



TOBACCO BARN BUILT OF BUSH TIMBER AND STRINGY BARK.

This shed is not sufficiently provided with ventilators.

The heating apparatus may be an iron stove, with pipes running round inside the shed, at 5 feet from the walls, and 1 foot from the ground, the chimney pipe taking the smoke out through the roof or wall. Another means of heating is to have outside furnaces, with flues running along the floor of the shed, and these are sometimes simply made by digging trenches through the floor, and covering with sheet-iron. Charcoal fires in tins will do the work in very small sheds.

For curing heavy tobaccoes larger sheds can be utilized, as the heat required is not so great. If the tobacco is to be partially air cured, the shed should be built so that it can be freely opened or tightly closed. A useful and cheap shed can be built on the following plan, where bush timber is available:—The corner-posts should be not less than 8 inches at the small end, and 16 feet apart each way in the square. They should be at least 4 feet in the ground, and 16 feet from the ground to the wall-plate. The first cross-beams should be let into the posts 9 feet from the ground, and should be not less than 5 inches in diameter at the small end, as the weight of the green tobacco that they will have to carry is considerable. On these poles are placed, running the length of the room, 4 feet apart. This will make the first floor. The next floor is made 3ft. 6in. above this, and the third floor the same distance above the second, bringing it level with the wall-plates. The roof should have plenty of pitch, and in this two more rows of tobacco can be hung on poles fastened to the rafters. The holding capacity will be about one acre, which, when cured, will vary from 800 lbs. to 1,500 lbs.

CURING SHED, MODERN STYLE (AMERICAN).

A skillion, 12 feet wide and 12ft. 6in. high on each side, will add to the carrying capacity of the shed, and be an improvement in supporting against wind. The sides can be made of paling or weather-board, and where bark is obtainable this latter will suffice. Shutters or ventilators should be all round the building, to enable the air to circulate freely throughout when desired, and the roof should be well ventilated. Such a shed can be extended to three rooms—that is, 48 feet—but longer than this is not advisable.

A very good shed in the north-east of Victoria is built of all bush timber, with Gippsland paling roof, and paling shutters for sides. The dimensions are 36 feet by 40 feet, including skillions, and the capacity is sufficient for four acres of tobacco. The cost is just under £30, all labour and material included.

The majority of sheds in use at the present time are unsuited to the cure of good tobacco, but could be made effective with a little additional trouble. The custom has been to build long, narrow sheds, with sides imperfectly closed, with bark or rushes to the height of the first floor. The intermediate space between this floor and the eaves is enclosed with cheap hessian, which is raised or lowered when desired. This is not sufficient protection against the changes of the weather, and the tobacco is at the mercy of drying winds or wet spells, and is either cured too fast or too slowly, and is often ruined after curing by constantly absorbing moisture, and again drying out with every change of atmosphere. Flavour and colour are lost, and in many cases the tobacco becomes half rotten through mildew on a great part of the leaf. A large proportion of Victorian leaf reaches the market in this damaged condition, and the reputation of the local tobaccoes suffers very greatly owing to this fault. The cost of the shed is not a very large item, and where it is found necessary to economize, well-built bark sides and roof will answer well. Thatch sides and roof will also make fair sheds, if made close and thick, the chief objection to these being the danger of fire.

Iron roofs are objectionable, owing to the drip caused when frosts melt, the tobacco being injured by contact with water even in such small quantities. Tobacco is not in the shed for the whole year, and the building will be found very useful for many other purposes, making a valuable asset on the farm.

Diseases.

With one exception, local tobacco crops suffer less from disease than the American. This is due, possibly, to the soils in Victoria being freer from contamination, owing to its almost virgin state. The one exception, however, is a serious one, in the shape of a fungoid disease known as "blue mould." This disease attacks the plants in the beds, just as they are ready to transplant, and, though a great variety of treatments have been tried to find a cure, none have been entirely successful up to the present time. This disease appears in the same kind of weather that induces rust in wheat, and is possibly akin to that fungus. The means so far proved best to cope with this trouble are more in the way of prevention than cure, and the system to adopt, in order to avoid the mould, is to have the beds in places sheltered from wind, on well-drained soil, and well away from standing water. Burning the soil is a wise step, and the use of virgin soil is also a good custom. The use of a dressing for the beds before planting, made of 1 lb. of sulphate of copper, 1 lb. of lime, to 40 gallons of water, appears to check the mould, but at the same time affects the seed, and the young plants do not thrive well. A solution of formalin also will check the disease, but this is not all that is wanted, and prevention is the only sure way to get good plants. If possible, have beds in several localities, with different aspects, and when the most suitable spot is discovered keep to that.

Pole Burn, a disease that attacks the leaf in the shed, is rarely known in Victoria. This is caused by too much moisture in the leaf during the curing stages. If it is observed, the shed should be well ventilated, or the temperature raised to 110 deg. F., at which degree the spread of the fungus is checked.

Calico, frog-eye, and Frenching are not known here, consequently there is no object in dealing with them.

Summary.

The foregoing remarks are intended to assist growers in a general way, with an insight into the cultivation and treatment of the tobacco crop. The varied conditions applying to the different soils and climates in this State will modify to a large extent any rules set down, and the grower will necessarily have to study the effects of his treatments as applied to the conditions in his special locality. It has been impossible to go fully into the scientific side of tobacco culture and treatment in this article, but, where possible, a study of the science of tobacco culture will be a great assistance to the grower, always providing due recognition of local conditions is considered.

In every new country experimental work is necessary to prove the variety suited to the soils, and types to be produced, and the effect of local conditions in climate, &c., on the curing process, and this work should be done by men with a knowledge of tobacco, or much time and labour may be wasted. That good leaf can be and has been produced in Victoria is proved by the sales of leaf in England in 1902, at prices ranging from 3d. to 6d. per lb., the average price for leaf in America being 5d. per lb. The recent experiments in growing cigar leaf show that there is a strong probability of good leaf being grown for cigar making purposes, and in America prices for this kind of leaf range up to 2s. per lb. for field-grown, and up to 16s. per lb. for tent-grown.

The opinion quoted elsewhere of tent-grown cigar leaf, by a manufacturer, shows that good leaf of this type can be grown under suitable conditions, and, seeing that the leaf was the result of a first experiment, is most encouraging. Later experiments show still better qualities. The local grower suffers from some disadvantages as compared with the American in that he has no buyers to take his leaf, and, from the various lots purchased, reassort and put the leaf upon the market in the most desirable form to the manufacturer. Again, the experience of several hundred years has established in America many facts that safeguard the grower from mistaken enterprise. A great amount of skilled labour is also available, whereas in Australia such labour is hard to find.

A reputation for the local product has also to be built up. But all this will come in time, and as a set-off we have large tracts of virgin soil which require less capital to secure, and the experiences of America as a guide to operations here. It rests with the grower to neglect no opportunity to improve the quality and reputation of the local tobaccoes, and so build up an industry that, judging by the profits obtained from the crop in other parts of the world, will materially improve the prosperity of the individual grower, and the community in general.

Notes of Interest.

Tobacco is not considered an exhaustive crop in America, and is grown consecutively for many years on the same soil, with the assistance of fertilizers.

The *seed* ash of tobacco contains about one-third phosphoric acid, one-third potash, and one-fifth magnesia. This is ten times more phosphoric acid, four times more magnesia, and one-fourth more potash than the *leaf* ash.

The area under tobacco in the United States is 700,000 acres. The average yield, 709 lbs. Tobacco farmers divide annually £12,000,000.

The acreage for the Commonwealth in 1903 was 1,308 acres. The average yield in Australia, computed over a period of ten years, was 884 lbs. per acre. The value of the 1903 crop to the producer was £13,000.

One tobacco plant will yield, when cured, leaf to the weight of 8 oz., averaging about 4 oz.

There are said to be 220 varieties of the tobacco plant.

The leaf surface of one acre of Havana tobacco has been calculated to cover more than four (4) acres.

One ounce of tobacco seed contains over 300,000 seeds, and a single plant has been known to produce three ounces.

The cost of growing tobacco in America in the field is estimated at from 2d. to 6d. per pound. This includes curing, and preparing for market.

Taken at the time of topping, the average tobacco plant contains about 3 per cent. of nitrogen, one-third of 1 per cent. of phosphoric acid, nearly 3½ per cent. of potash, and 3½ per cent. of lime.

The cost of the machinery required to work the tobacco crop is small, the average farmer having all that is actually necessary in the shape of plough, harrows, cart, scarifier, and hoes.

One man can attend to four acres of tobacco, with assistance for two weeks at planting time and three weeks at harvest time. A boy will be found all that is required at such times.

Tobacco crops must have constant attention from the time the plants are put in the field until harvested, about twenty-two weeks.

Stripping can be done by a smart boy at the rate of 100 lbs. per day.

Plant beds for four acres can be made in two or three days, and will require a few odd days for weeding and watering.

It can be estimated that, for attending to four acres of tobacco, a man's full time will be about seven months in the year.

Tobacco improves greatly with age after curing, and should be at least two years old before used, and will continue to improve for five years, if properly stored.

SOILS AND CLIMATES FOR PRODUCTION OF CIGAR LEAF.

Until quite recently the production of cigar leaf has received little attention in Victoria, probably owing to the fact that erroneous ideas exist in the minds of many farmers, in regard to the labour and return from such tobaccoes. It is frequently said that the culture of cigar leaf will not pay here, owing to the cost of labour, and the small yield per acre as compared with other classes of tobacco. It is true that some cigar tobacco varieties give small yields, and require sometimes twice the number of plants per acre, but there are other varieties that give as large yields as the heaviest plug tobacco, and require few more plants to the acre. Cigar tobaccoes command, on an average, twice the price of plug leaf, consequently, even if the labour is greater, the acreage to be attended to is smaller, and the proportionate return larger from a monetary point of view. That some of the soils on which only plug tobaccoes have been grown for the past 30 years, are better fitted to produce cigar tobaccoes, has lately been proved. The success of the cigar leaf has been so marked in proportion to the extent of the experiments tried that there is every reason to suppose that a further great improvement in the leaf will yet be obtained by systematic selection of soils, and climates suited to the different types and classes of leaf. In America, it has been found that certain districts that produced only an inferior plug leaf, produced a first-rate cigar leaf, when the variety to suit each particular district was proved.

INTERIOR OF CIGAR HOUSE, ED1.

There are many different classes of leaf required for different purposes in the manufacture of cigars, and even in one cigar. For instance, there is the filler leaf, which is the greater portion of the cigar, and is chiefly concerned in making the flavour and aroma of the cigar. Then comes the bunch wrapper, which holds the filler leaf in shape, and this leaf must be elastic, with fine texture, and good burning quality. Lastly, the outside wrapper, which must be sound, silky, and elastic, with a fine texture, small rib, and nice appearance should be sufficiently tough to stand the strain of rolling and pressure without breaking. The colour also must be that required by the popular taste. Some of the best Sumatran wrappers are wonderfully thin, silky, and tough, one pound of the leaf being sufficient to wrap as many as 500 cigars. This leaf brings prices ranging up to 20s. per lb., and is one of the highest-priced tobaccoes grown. The bunch wrapper comes next in value, but far below that of the outside wrapper, the filler being the cheapest portion of the cigar; this latter is rarely all made from one class of leaf only, but is mixed by the manufacturer from different tobaccoes, in order to get the exact flavour required. It is very rarely indeed that cigars are made from one class of leaf only, as it will be seen from the foregoing remarks that different qualities are required in the fillers, wrappers, and binders.

Now, in order to produce these special classes of leaf, certain varieties of the plant must be grown in soils and climates that will bring out their best qualities. The only certain plan to accomplish such results in a new country such as this in regard to tobacco culture, is to test each particular locality with several of the leading varieties of both cigar and plug tobaccoes, and to submit the leaf when cured to men competent to judge its merits. Then, when the most suitable has been discovered, keep to that kind only, and endeavour to produce the correct type by treating it with the most up-to-date methods of cultivation, curing, fermenting, &c. This is most important, as buyers expect to get certain types for special purposes in order to keep a regular quality in their goods. A nondescript tobacco will never be of the same value to them as an article they know and can rely upon. To attempt to produce a bright lemon-coloured leaf on a heavy, stiff, dark soil is to court failure, and to attempt to produce a good heavy dark tobacco on light sandy or slatey soils is equally sure to fail. No chemical and mechanical analyses of soils are sufficient guides to a grower in a new district, as to the exact type of leaf his soil is best fitted to produce, though it may materially help in the choice of varieties with which to experiment. The soils used in the Connecticut Valley for the production of the best cigar wrappers are light, alluvial sandy soils, bordering the Connecticut River; the lighter the soil the better the colour and texture, but the lighter the yield. On the heavier soils in the same neighbourhood crops of 2,000 lbs. per acre are harvested in a good season, but the quality is lower than that from the lighter soils.

In Ohio, cigar fillers are grown on a reddish clay.

In Florida, fillers and wrappers are grown on light sandy loam, with a reddish subsoil.

In Tennessee, cigar fillers are grown on limestone country.

In Pennsylvania, cigar fillers and wrappers are grown on limestone and red soils.

In Virginia, light grey sandy soils are used to grow the leaf for cigar wrappers and cigarettes.

Potash is the chief plant food necessary to the tobacco plant, not only as a food, but also to improve the leaf's burning qualities. Lime, nitrogen, and phosphoric acid are the next most important. Very strong nitrogenous soils, however, do not produce the best qualities in the leaf. A large percentage of chlorine in the soil is bad for tobacco, and will spoil its burn. For this reason, where potash manures are used, only high-grade fertilizers are best, as they contain the smallest percentage of chlorine. The best form of potash to use is the sulphate. Where the soil is rich and the texture of the leaf too coarse, this defect can be obviated by planting closer. Some cigar tobaccoes are put only a foot apart in the row, with 3 feet to 3 feet 6 inches between the rows, to allow for cultivation with the horse-hoe.

Climatic conditions have a great influence on the quality and aroma of tobacco, and it is said that the plant is more sensitive to meteorological conditions than the instruments used for taking records. In a hot climate the leaf will be gummy and aromatic; in cooler climates the tendency is to thinner leaf, with less aroma. Where, however, the rainfall is heavy in a hot climate with the proper conditions of soil, the leaf is thin, as in Sumatra. Dry weather, from the topping stages of the plant, is favorable to the development of the oxydizing enzyme, which bears such an important part in the curing and fermentation of the leaf. If dry weather during the ripening of the leaf is accompanied with dews at night, the tobacco will be gummy, and cure well. Dry, hot weather causes the leaf to be thick, and tobacco grown in a humid atmosphere, or under cover, will be thin. Very wet, cold weather in the later stages of growth will cause the leaf to be bitter, and cure badly. The deduction therefore is, that tobacco will thrive best in warm climates, with sufficient rainfall to keep the plant growing to the ripening stage. The hot, or cooler climate, together with soil conditions, determines the type of tobacco best suited to each locality.

The mean monthly temperatures during the growing months in the cigar-producing districts of America, range from 44.80 deg. F. to 83.05 deg. F. The rainfall average for the same months, *i.e.*, April, May, June, July, August, September, is about 3.61, 4.70, 3.91, 4.06, 3.96, 3.68. It will be noted that the temperatures and rainfall correspond very nearly with those of some parts of Victoria, during the growing months here, viz., November, December, January, February, March. A comparison of the soil analyzed of parts of Victoria and the cigar soils of America shows them to be very similar. This being so, it appears that if the correct varieties are found to suit each district, and proper methods of treatment adopted in the handling of the crop, we should produce leaf equal to the American.

Cigar leaf of some class can evidently be produced in many different climates and soils. It is not considered wise to grow tobacco within thirty miles of the sea-board, as the plant is liable to assimilate too much salt, which would interfere with combustion. Tobacco leaf containing a large percentage of chlorine, as compared with the potash content, will not burn, and is sometimes absolutely useless for smoking purposes. Good drainage is essential in all soils for tobacco culture. Where the rainfall is scanty and irrigation is possible, the latter will be found of great advantage, provided it is done with due judgment, with regard to the requirements of the plant. The crop should not be irrigated after the bud has been nipped out, neither should the water lie on the ground for long at any time, the object being to keep the plant growing until the ripening stages are reached. Tobacco, grown quickly, is always better in general qualities than that grown slowly. Too much water in the soil will have a detrimental effect on the quality of the leaf grown, and the higher the percentage of water contained, the heavier and coarser will be the product. The best tobacco soils in the Connecticut Valley, America, for producing leaf of the finest texture and quality, contain, on an average, only 7 per cent. of water. This soil is very porous indeed, and the rainfall regular. Other soils in the same valley produce a lower quality leaf, though heavier soils contain as high as 20 to 25 per cent. of water. The same results have been noted in all the other cigar districts. The nature of the soil, the climatic conditions, together with the water content of the soil, determine the character of the tobacco to be produced. The leaf is grown for so many different uses, that it is most necessary that only the best of each particular type should be grown. Colour, flavour, strength, elasticity, body, aroma, texture, have all to be considered, and all these qualities vary more or less according to the use the leaf is required for. In America each different district is known for its particular type of tobacco, and the suitability of certain varieties to each district, in order to produce that type, has been proved by a series of experiments, and the same procedure will have to be followed in Victoria for some time, before we can hope to establish the tobacco industry at its best here. This is the more emphasized by the fact that the general quality of tobacco smoked now is better than that used a few years ago, especially in Australia. Americans realize this, and their constant aim is to improve their product by selection, cultivation and treatment. The early history of tobacco culture in America, shows that very low quality leaf was grown in some of the present leading tobacco-producing districts, but by constant study of the plants' requirements, and elaborate experimental work, a so much better leaf has been evolved that at the present time her reputation as a tobacco-producing country is second to none in the world. We, in Australia, have to make a reputation for our product, and we cannot do better than follow the lines adopted in America, where some four hundred years' experience is available as a guide to operations here.

It is, perhaps, not generally known that in some parts of Victoria the tobacco plant (Genus Nicotiana) grows wild, in some cases, most vigorously, and shows strong resemblance to well-known cigar varieties. The fact that it so readily adapts itself to our climate and soil, indicates that they are more or less suited to its development.

CIGAR HOUSE, TOBACCO BARN AND RESIDENCE AT EDI.

CHAPTER XII.

VITICULTURE.

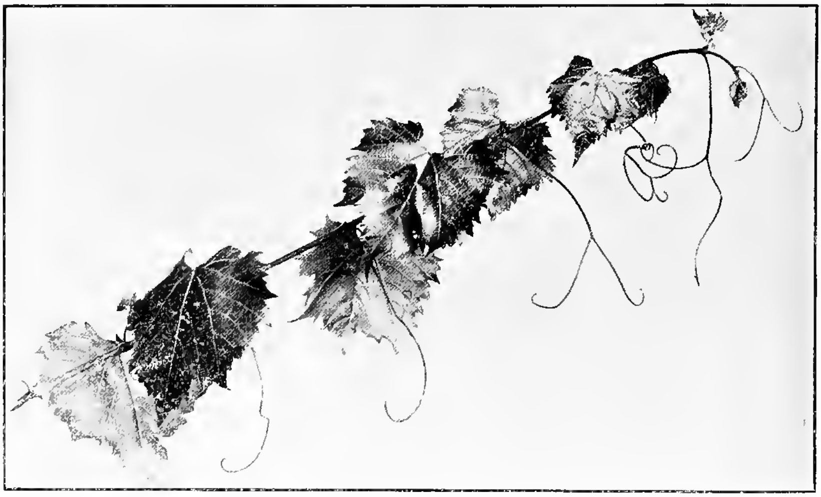
RIPARIA GLOIRE.

RECONSTITUTION OF VINEYARDS.

When it was definitely decided that the dreaded phylloxera was actually devastating the vineyards of Europe, and that the formidable pest had been introduced on some of the native vines of America, some of the keener viticultural scientists of France were convinced that there must be some vines that, in their native home, were able to withstand the attacks of the insect. They argued that since *Phylloxera vastatrix* feeds only on plants of the genus *Vitis*, it could only be a matter of greater or less time before all vineyards and vines would be destroyed. Then, unless the parasite changed its food, it must die out too. It would be, so to speak, committing "race suicide" by killing its host plant, and thus destroying its supply of food. They contended that there must be some variety at least, able to withstand the ravages of the tiny invader, and they set themselves the task of investigation, and, if possible, discovery.

With the promptness and liberality which has so often characterized the French Government in researches of this nature, they sent out a Commission composed of the most eligible available men to the United States to study that very important question in the habitat of both the phylloxera and the American vines. The result was the discovery of the resistant varieties, some of which, with their selected hybrids, we are now utilizing in the reconstitution of our vineyards.

It may be here remarked that no vines are actually *proof* against phylloxera, but they may *resist* its attacks. Resistant vines are those that are not seriously injured by the attacks of the insects. The roots of those with a high resistance are hardier and protected with stouter coverings through which the proboscides of the little parasites cannot pierce. Thus their food supply is restricted, and the insects cannot multiply as rapidly as on the roots of European vines, where their food is readily obtained.



RIPARIA GRAND GLABRE.

Then, too, in the case of the resistant vine, the injured bark of the root is sloughed off or shed every year, and the root itself sustains no perceptible damage. The phylloxera and the American vine have, we might say, been brought up together. Those plants without natural protection were attacked and speedily succumbed. The more robust and better protected were the fittest to carry on the struggle against phylloxera. Those survived. They perpetuated their species by seed. In her ordinary way, by cross fertilization, Nature strove to produce healthy offspring. Many seedlings would possess the protective character inherited from the parent plants. Those that did not possess the necessary resistance fell ready victims to the insatiable phylloxera. Nature, inexorable, adopted this method to weed out the feeble and secure a high standard of resistance. The test was a severe one. Some vines probably struggled on for a while under the false protection of a limited resistance. Finally they too died. Nothing short of considerable protection would avail in this struggle. Generation by generation the process was continued and perfected. Nature unceasingly carried out her self-imposed task, and we have the result to-day in the American resistant vines. After this long and severe training in Nature's experimental station, they are ready for us to reconstitute our rapidly dying vineyards in phylloxerated areas.

After the discovery of vines that were able to flourish in spite of the parastic insects, they were soon introduced into France for reconstitution purposes. Grave mistakes were made. Disaster in many instances followed, and for a time at least American stocks were discredited. Some vignerons thought that all American stocks were equally resistant, and only after considerable lapse of time and expenditure of capital was the error discovered. Some used seedlings, which we know, from our ordinary garden experience, do not invariably come true. Varieties unsuited for certain soils were planted in unfavorable localities. Climatic conditions were not always considered. Even in those cases where the stocks themselves grew well, they were not always successfully grafted. Grafts showing want of affinity with the selected stocks were sometimes used, and serious loss again resulted. Plantations were hastily made without due preparation of the site. Thorough and deep cultivation with attention to drainage did not receive due consideration. The American vine to succeed thoroughly requires deep preparation of the soil. In France and Algeria large areas had to be uprooted as unproductive because the soil had not been sufficiently prepared. After deeper cultivation these areas were replanted with the same varieties, and repaid by their prolific yields.

For a long time the American vines were prohibited in our State. For years the writer persistently, but unsuccessfully, advocated the adoption of such means as had proved so successful in the conflict between the vignerons and phylloxera in both the old and new worlds. Eventually they were introduced in 1900. To test their adaptability to the various conditions of soil and climate in our viticultural areas, experimental stations were established. These were placed under my charge, and during a series of years valuable data were carefully recorded. This information, obtained in a practical manner, and under ordinary every-day conditions in the districts concerned, has already proved of immense value. The cost incurred by the establishment and maintenance of these experimental nurseries was money judiciously spent. It is satisfactory to note that, as a result of these experiments, reconstituted vineyards are already coming into bearing in our State, and give promise of prolific yields. It is to be regretted, however, that more experimental viticultural work cannot be undertaken.

To successfully reconstitute our vineyards, as has been done in Europe and elsewhere, we must understand the nature of our vines. Of the stocks we must be assured about their resistant qualities, their adaptability to soils and climatic conditions, and also, most particularly, their grafting affinities.

Nearly a score of species of vines indigenous to America are known. Of these but few are of practical interest to the vigneron. These are chiefly Riparia and Rupestris species, and include a number of varieties under each. Beside these we have also a number of hybrids, obtained with much perseverance and care by hybridisation. Those hybrids which have stood successfully the various tests of resistance, adaptability, and grafting affinity, are among the most valuable contributions to viticultural science from a reconstitution stand-point.

RIPARIAS.

The Riparias, as their name indicates, are plants that, in their native habitat, love the moist, fertile soils along water-courses. Their root-system is spreading and inclined to be horizontal; hence they may be classed as surface soil feeders. The roots are thin, hard, and strong. Placed in conditions such as they are naturally accustomed to, they grow luxuriantly. At Mildura and in the Goulburn Valley, and other irrigated parts, the growth is almost phenomenal. There the ample water supply and other conditions of growth approximate more nearly to the natural conditions of these plants, and canes of enormous length are produced. It is interesting to note that the great bulk of reconstitution in France has been done on Riparia stocks. From the description it will be gathered that Riparias are not so likely to succeed in dry, poor soils. They are, owing to the shallower nature of their root-system, somewhat susceptible to drought.

RUPESTRIS.

Unlike the Riparias, which are spreading and trailing in their habit, the Rupestris grows more erect and bushy. The young wood is usually of a reddish tinge. As will be gathered from its name, it is found in drier soils, among stones and rocks. It is sometimes called the sand grape in America. Rupestris is as distinct from Riparia in its habit of root as in its general habit of growth. It is a deep-rooted species, hence deep cultivation or subsoiling and perfect drainage are essential. The absence of the latter, either natural or artificial, is liable to cause trouble with these, or, in fact, any plants. Several varieties of Rupestris are used as graft bearers with good results, particularly in drier localities, as from the character of its root-system it is able to withstand drought.

HYBRIDS.

Most of the hybrids in actual use as stocks have been obtained by hybridising the two species already mentioned, viz., Riparia and Rupestris. In the breeding of stock, or any of our domestic animals, it is found that the progeny of a "cross" usually exhibit points inherited from both parents. In the "plant-breeding" experiments, with resistant stocks, it is not too much to claim that some of our hybrids have inherited the good qualities of both parents, and as one result of this, they can adapt themselves to most conditions of soil and climate. These hybrids are usually designated by numbers. Many thousands were obtained only to be discarded as useless when put to the necessary practical tests already alluded to, viz., resistant qualities, adaptability to soils, and grafting affinity. The most meritorious are:—

Riparia × Rupestris, No. 3306.
,, × ,, No. 3309.
,, × ,, No. 101^{14}.
Mourvèdre × Rupestris, No. 1202.

RUPESTRIS DU LOT.

RUPESTRIS GANZIN.

Grafting.

To prepare for successful grafting we must grow the wood carefully. The best way is to grow the canes on trellis, and by judicious care and disbudding at the right time, we may produce the desirable growth, known as good grafting wood.

After the leaves have fallen, and when the canes are fully ripened, the cuttings are made, tied in handy bundles, and stratified in sand till required. By stratification the wood is rendered much easier to work and is less brittle, and is also kept in perfect condition.

Grafting is done by hand and also by machines. Rootlings or permanent vines may, of course, be grafted in the ground, but it has been found more economical to practise what is known as bench grafting. The scion of desired European variety is inserted on a cutting of the approved American resistant vine. The unification of the two and the callusing for root formation go on simultaneously, and much time is saved. The piece of American vine which is to form the stock is taken, and all the buds are removed. At public demonstrations of grafting, I have often heard surprise expressed at this. Some growers actually assert that, by doing this, we destroy the prospect of growth of the stock; but, of course, this is not so. The object in removing eyes from the stock is to prevent, as much as possible, the formation of suckers. A machine of simple but ingenious construction prepares scion for the stock, and the stock for the scion. By changing the fluted metal tables provided with these grafting machines, and adjusting the cutting blades, a great variety of grafts can be made.

The scions or grafts of the approved European variety are as carefully prepared. These consist of one or two buds. If the latter, they have an additional chance to shoot, but being longer the grafts are more liable to be knocked and misplaced during handling. Stock and scion make the best union if uniform in diameter and close-fitting. If of different sizes the inner bark and cambium layers of stock and scion should be in contact on one side. Care should be taken to secure this, and also to prevent unnecessary drying of the grafts during operations. If hand grafting is practised, the whip-tongue and cleft grafts are about the most conveniently made. Tying with raffia completes the operation, as far as grafting is concerned; and unless the grafted cuttings can be placed at once in sand, it is advisable to cover them, till that can be done, in moss, to which a little powdered charcoal has been added.

Grafting is a comparatively simple operation, but the subsequent care of the vines is even more important and difficult. They must be more carefully tended. Having been tied up in suitable handy bundles, they are placed in sand under glass frames. These frames are left open during fine days, but are closed during cold nights and wet weather. The sand is kept moist, but not too wet, and as far as possible an equable temperature is maintained. Both the temperature and the degree of moisture are under control with the use of frames. Such would not be the case if the grafted cuttings were planted at once in the open ground. Under this treatment they soon show signs of callusing. The scion and stock begin to knit together, and root callus and rootlets form. As soon as the season is far enough advanced these cuttings are planted out, either in nursery rows or in their permanent position in the vineyard. They are covered up with sand through which the growing shoots soon penetrate. Care must be taken to cut the raffia used in tying the graft, and also to rub off any suckers that may appear on the stock, in spite of the precautions taken to prevent their growth.

It is claimed that grafted vines come into bearing at an earlier period of their growth, and are more prolific than ungrafted. The reasons are perhaps hardly fully understood, but it seems that the circulation of elaborated sap is somewhat retarded, and is utilized by the plant in the production of fruit, as is the case with vines that have been cinctured.

The present is the time when preparations must be made for the grafting of the resistant stock, and it is to be hoped vignerons will not overlook the necessity for reconstituting their vineyards. If the important viticultural industry is to take the place that its possibilities warrant, no time must be lost.

For those who prefer to purchase the vines already grafted it may be stated that a very large number of suitable wine, table, and drying varieties were grafted on selected American stocks at the Rutherglen Viticultural Station, and will be offered for sale during the coming planting season.

To those about to plant, my advice is:—Thoroughly prepare your land by deep cultivation and attention to drainage. Use only stocks of approved resistant qualities, vigorous growth, adapted to your particular soil and climate, and of known grafting affinity. Give them all the care possible, and you may expect that, like all our cultivated plants, they will respond to generous treatment, and make ample return for your attention. As suggested in my last annual report, it is desirable to reconstitute where necessary a small area each year. This distributes the cost over several seasons. By the time the last portion of the old vineyard has become worthless from the ravages of phylloxera, the part first reconstituted on American stocks will be coming into bearing.

AMERICAN RESISTANT VINES.

The vine, probably the oldest cultivated plant, has representatives in the indigenous floras of all the continents. The natural order in which botanists place vines is known as *Ampelideæ*, though the name *Viniferæ* was adopted by the late eminent Baron von Müeller. The genus is *Vitis*. This name is said to have been given from a Latin word signifying to twist, and has reference to the characteristic twining of the branches. Others, however, consider the name to have been derived from a Celtic word meaning "the best of trees," in allusion to the useful products of the vine.

The so-called European vine (*V. vinifera*) is endemic in both Europe and Asia, and has been in regular cultivation since pre-historic times. Its geographic range was formerly much greater than at present, for the indisputable records of the rocks in many places show it to have once flourished over areas where now, owing to climatic changes, it could not naturally exist. Varieties of this species, obtained largely by selection, are now numbered by thousands, and supply us with all kinds of grapes for table, wine, or drying purposes. Asia has also other representatives of the genus, but they are not of much interest from a viticultural stand-point. The same also applies to the native vines of Africa, though it may be of passing interest to notice that the natives of Madagascar affirm that the berries of a wild species in that island are deleterious—a statement requiring further confirmation.

Australian representatives number some seventeen species (Müeller), of which perhaps two are found naturally growing in our State. These Victorian species, unlike our cultivated vines, are evergreen. Attempts to graft, cultivate, and thus improve them, have been made from time to time, but so far without much success. Baron von Müeller states that Mr. E. Giles, the explorer, made "some wine of fair quality, reminding of claret," from *V. acetosa*, a Northern Australian species met with on his travels.

Resistant Stocks.

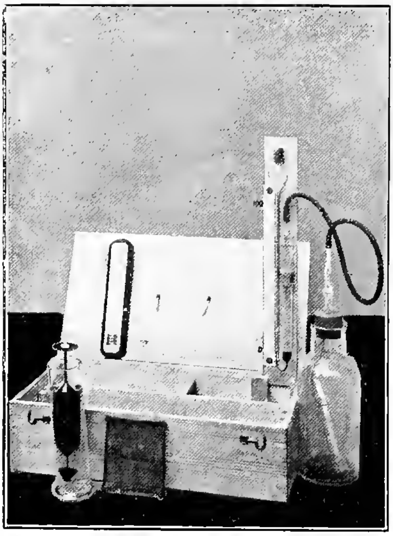
But it is with the American species, their varieties and hybrids, that we are now more particularly concerned. These vines have, of recent years, come under prominent notice owing to their resistance to the ravages of the deadly phylloxera. These stocks resist the attacks of phylloxera by the possession of a better root protection, and also by annually repairing any slight injury that may have been received from this source. As the injured part is cast off each year, the tiny insects can do no permanent harm to the roots of truly resistant stocks. Like the mythic Sisyphus, who was condemned to roll up hill an ever-returning boulder, the phylloxera has an endless task, without making any lasting advance or progress in the destructive work on these stocks as compared with the devastation on European vines. The resistant properties and vigour are increased or reduced as the vine is planted in suitable or unsuitable soils.

It cannot be too strongly impressed that the stocks, to be of any value, must be resistant to phylloxera, vigorous in growth, adapted to the particular soil where they are to be planted, and possess grafting affinity for the desired scions.

The American vines imported into this State were selected for their resistance to phylloxera and vigour of growth. During several years series of experiments were carried out here to test adaptability and grafting affinity, and these data are now available.

INFLUENCE OF EXCESS OF LIME.

Most of the resistant stocks are unfavorably influenced by the presence of a large proportion of lime in the soil. Under such conditions they become affected with chlorosis, and may even succumb. To determine the percentage of lime in the soil, various forms of calcimeters have been adopted. The writer uses that of St. René. A given quantity of the soil to be tested is weighed by means of the hydrometer. This sample of earth is finely powdered and sifted, and placed in a glass jar. A small test tube, containing diluted hydrochloric acid, is lowered also into this receptacle, which is then corked tightly. A glass tube passing through the cork is connected by a rubber pipe, with a graduated scale. By inverting the glass jar for a moment the acid is poured over the sample of soil, and carbonic acid gas is liberated. The gas passing along the tube exerts pressure on the mercury in the manometer, and it automatically records the percentage of lime in the sample under test. Slight corrections have to be made according to the temperature. The rate at which



APPARATUS FOR DETERMINING PERCENTAGE OF LIME IN THE SOIL.

the carbonic acid gas is liberated gives an approximate idea also of the assimilability of the lime in the soil, though this cannot be regarded as always reliable.

For calcareous soils the *Berlandieri* stock is most suitable, as will be subsequently described.

Vitis Riparia.

Vitis riparia, or the river-side grape, is naturally found over a wide range of latitude, and withstands extremes of temperature fairly well. Riparias are early in starting into growth after the dormant season, and the tender shoots are then liable to be injured by frost. This is, of course, only when ungrafted. The varieties with large, shining leaves are regarded as the most suitable for cultivation. Being, as the name indicates, riparian in their habits, these vines revel in moist, river-side situations, but they do not thrive in marshy or undrained soil. In fact American vines require proper drainage, and a thorough and deep cultivation of the soil. In this respect they are not peculiar. It may be remarked, in passing, that the value of drainage cannot be too strongly emphasized. Where stagnant or excess of water is present, the root system cannot properly develop. Both the stagnant water and succeeding drought act in a decidedly injurious manner on the tiny root hairs, and as these are the media of supplying the plant with its water and the dilute plant food derived from the soil, it follows that the plant deprived of these hairs must suffer and eventually die. If vigorous growing varieties are grafted on stocks planted under such adverse conditions, the evil is accentuated. The demands of the quick-growing graft cannot be satisfied, and disaster naturally and speedily follows. Many cases of failure on the part of grafted vines during their early years are attributable to this cause.

RIPARIA GLOIRE.

One of the most successful and extensively used graft bearers is *Riparia gloire* (*de Montpellier*), synonym *R. portalis*. The stem is robust, the vine is of vigorous growth, producing in suitable localities canes of phenomenal length; prostrate or climbing in habit. The wood is hazel coloured, flat near the nodes, with long internodes. Canes frequently have a somewhat angular or zigzag appearance, owing to the slight angle or bend at the nodes. The bark is smooth and thin, often showing a delicate bloom. The leaves are large and shining, and appear as if inflated between the main veins, prominently toothed, with smaller teeth interposed; under page of leaf lighter green. Root system spreading and inclined to be horizontal and near the surface, rendering the plant susceptible to drought. Roots slender and wiry.

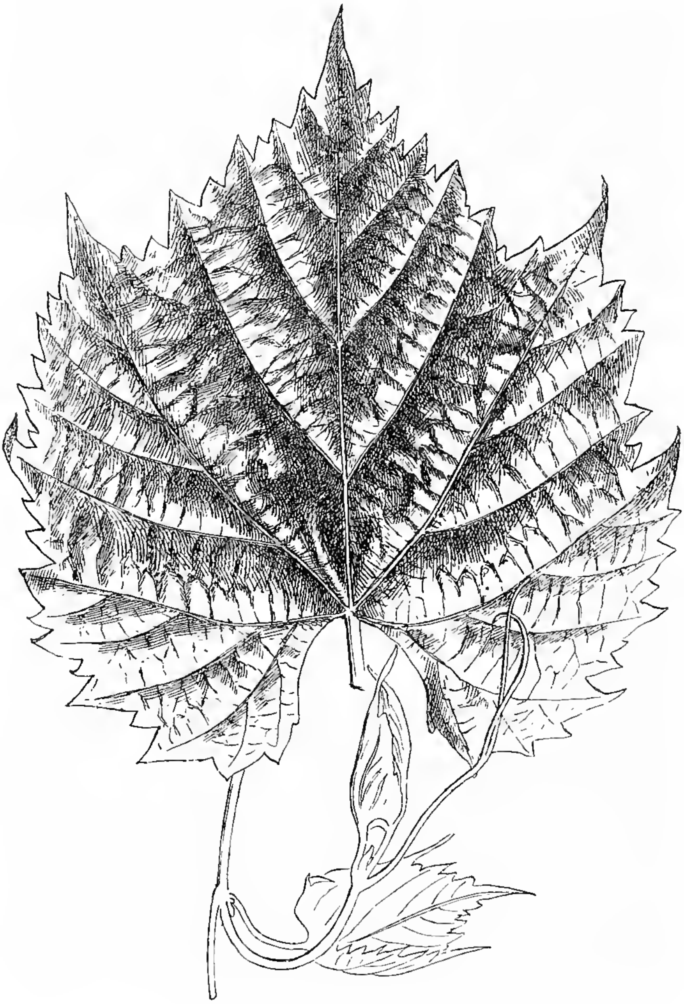
Resistance, 18. Twenty represents absolute immunity.

Adaptability.—For moist, rich, loamy soils, containing less than 25 per cent. of lime (Föex) and not too wet, these plants are admirably adapted.

RIPARIA GRAND GLABRE.

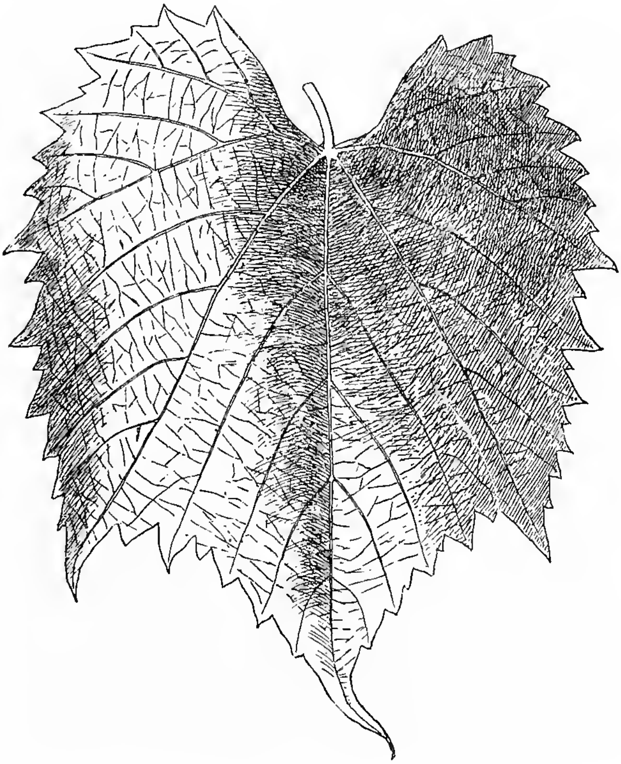
The trunk is slender, producing vigorous and long canes. Wood reddish, covered with bloom, secondary shoots frequent. In its habit of growth and shape of leaf this variety resembles *R. gloire*, though the leaves on *R. grand glabre* have more parallel sides. This cepage is said to withstand drought better and adapts itself to less fertile soil than the other Riparia, though in some districts it is less vigorous in habit. It came into early and rapid prominence on account of its resistance also to chlorosis.

Resistance against phylloxera, 18.



LEAF OF RIPARIA GLOIRE.

Grafting affinity.—Both the Riparias described are good graft bearers, and have been largely used in France, where by far the larger part of the reconstitution has been done on these stocks. They impart great fertility to their grafts, which come into bearing at an early age, and produce freely. The cuttings of both varieties strike readily, and, after bench-grafting, quickly unite with the scion during stratification. Reconstitution on these stocks has been successfully accomplished in Victoria, and wine made during the third year after planting. Mr. T. Darveniza, proprietor of the well-known Excelsior Vineyard, Mooroopna, whose 15 acres of reconstitution include a considerable portion on Riparia stock, made 3,500 gallons of wine last vintage from the 15 acres. Considering that there had been some failures to grow owing to the drought, and that the vines were only three years planted, the results must be regarded as promising.



LEAF OF RIPAPIA GRAND GLABRE.

Vitis Rupestris.

Having briefly reviewed the varieties derived from *V. riparia* that have been found of value in the reconstitution of vineyards, we now propose to study the *Vitis rupestris* and its cepages. As in the case of the Riparias, we shall confine our attention to viticultural desiderata, and pass without notice the very many varieties of this species that have not proved their utility, and have been consequently eliminated. Rupestris in its native land is known under a number of popular names, *e.g.*, Sand, Mountain, Rock, or Sugar Grape. As the etymology of its specific name indicates, it grows naturally among rocks, along stony ravines and rocky hill-sides. From this it will be seen it is naturally adapted for growth in gravelly, rocky, and drier soils than the Riparias. It is also equally adapted to sandy situations. Those varieties of robust habit, with strong canes and thick shining leaves, are found the most eligible for viticultural purposes. In general habit of growth and appearance the Rupestris are quite distinct from the Riparias, which are rambling or spreading. The former are of more upright, bushy habit, but still of vigorous growth and robust constitution. They have been proved good graft-bearers, provided the grafting is not delayed till the stocks are too old, when the operation is not always so successful. Having a stouter and more robust trunk than the Riparias, the growth of stock keeps pace with that of the scion more evenly, and there is in consequence less liability to the discrepancy between stock and scion which is so often noticed and objected to in other species.

The root system of the Rupestris is also as characteristic of the species as is the general habit of growth. On its deeply penetrating roots depend the drought-resistant properties which have rendered this species so valuable in dry districts, such as those included in our northern viticultural areas. The roots are long, strong and hard, possess a high resistance against phylloxera, and the plants thrive and grow vigorously in soils not remarkably fertile. Owing to the deep-root system, drainage and deeper cultivation are more essential to success with these varieties. *Pourridie* (a comprehensive name for root fungi) often attacks vines of the Rupestris species. My experience shows, however, that this is in all cases attributable to want of or defective drainage, or the presence—so frequent in our soils—of decaying stumps and roots. The young wood of Rupestris has usually a reddish tinge, and the internodes are much shorter than in Riparias. Cuttings strike freely, but have a tendency to throw up suckers, hence in bench grafting it is usual to eliminate all eyes that are to be placed below ground. On the whole, the varieties of Rupestris are somewhat more tolerant to lime than those of the Riparia strain, though an excess acts prejudicially to their growth. Rupestris lends itself readily to hybridization, both natural and artificial, and from the latter we have derived meritorious forms, to be subsequently described.

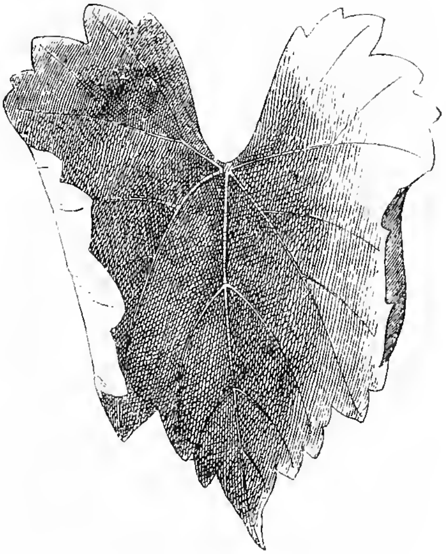
RUPESTRIS DU LOT.

This plant is also known under a host of synonyms. The name adopted in Victoria is an abbreviation of its fuller title, *R. phenomène du Lot*. In California, where it is highly valued, this variety passes under the name of *R. St. George*. The habit of R. du Lot is decidedly erect, and the stems are robust. The wood of young plants is reddish in colour, resembling that of seedling apricots. Owing to short internodes, the nodes are frequent. The leaf buds are daintily tinted, and the leaves are a bright green, possessing a somewhat metallic lustre. In shape they would be almost square but for the pointed apex, and the whole leaf is folded along the mid-rib. This latter characteristic is more pronounced in the height of summer, and gives the idea at a distance that the plant is wilted and suffering from want of moisture. In most vines the leaf is joined to the leaf-stalk in a more or less deep recess, known botanically as the petiolar sinus. A distinguishing feature of R. du Lot is that the petiolar sinus is bracket-shaped. The flowers are all staminate, producing pollen only, and therefore never set seed. Like European varieties, this vine also resists the formation of leaf-galls, such as are caused by the puncture of the gall-producing form of phylloxera (Mazade). Punctures simply cause deflections of the veins. As leaf-galls are usually common on the American vines, this is rather singular.

The roots penetrate deeply in search of moisture and plant food, but are less wiry than those of other varieties. Phylloxera have been known to make wounds on the roots, and for a time this led to the apprehension that this cepage was not resistant. Excoriation, however, soon repairs the very slight injury sustained, and the resistance is estimated at from 16 to 19½ (Foex) when 20 represents absolute resistance. This variety is not so readily affected by the presence of lime as are the majority of resistant stocks, possesses as already indicated, highly resistant powers against phylloxera, and is an excellent graft-bearer. It is adapted for dry situations, thrives in gravelly or more compact clay soils, and shows to advantage in our northern vineyards. As a stock, it imparts considerable vigour and fertility to grafts, whose exuberant growth, however, requires suitable pruning, or "coulure" (non-setting of the fruit) may result.

RUPESTRIS MARTIN.

This is one of several varieties introduced into France from Texas, and it bears the name of the French grower who first cultivated it in his vineyard. It is a vigorous grower, producing strong canes, with short internodes. The leaves are of a lighter green beneath than on the upper surface. This stock is highly resistant against phylloxera (18-19½), and a successful graft-bearer. It thrives in indifferent soils, and is said to be the most highly esteemed stock in the dry soils of the Island of Madeira. In soils similar to, and even drier than that indicated for R. du Lot, it



LEAF OF RUPESTRIS MARTIN.

succeeds admirably. Two distinct types were imported into this State under this name, and we have distinguished them as Nos. 1 and 2 respectively. Though there are notable exceptions, yet, on the whole, and taking all districts into consideration, it must be confessed that R. Martin has not so far quite upheld the reputation with which it came to us. In France it is probably the most popular of the Rupestris strain. There thirty years' experience has not lessened the esteem with which it is regarded by vignerons whose soils are of a dry character and do not contain too high a percentage of lime. In Californian reconstitution this stock, too, holds a distinguished place. It may here be remarked that in the experiments carried out by the writer during several years, to test the adaptability of the various resistant stocks, it was found that several varieties do not, under our conditions, furnish the same results as are recorded from elsewhere. Growers will see how necessary it is to test each variety, and will appreciate the value of the experimental work undertaken.

RUPESTRIS GANZIN.

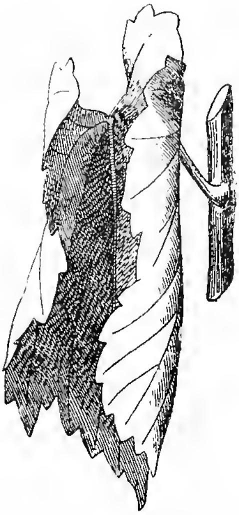
This is another of the resistant stocks for which we are indebted to Texas. In habit it is bushy and robust, with vigorous growth. The young shoots are tinted bronze-green, and the mature wood is richly coloured The leaves are distinct, and easily recognised by the prominent coloured veins or ribs and grooved, red leaf-stalk. The under surface of the leaf is of a paler green and duller appearance than the face. The foliage assumes bright autumnal tints, and is in great demand for decorative purposes. Though not introduced by Ganzin, it was scientifically studied at his vineyard in its early economic history, and consequently has been distinguished by his name. In France this variety is somewhat discountenanced in favour of R. Martin, yet we have found it a vigorous grower and a successful graft-bearer. Its resistance against phylloxera is estimated at 18, and it adapts itself readily to such soils and conditions as are indicated for its rival R. Martin. With us it is a stock of considerable promise. Hybrids between this variety and Aramon have been obtained, and have proved their resistant and graft-bearing capabilities. They succeed well in quite a variety of soils, but are very susceptible to the presence of lime.

RUPESTRIS MISSION.

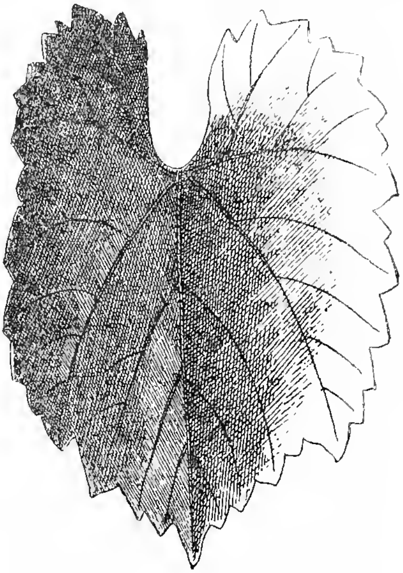
This variety has not been largely used in our Victorian reconstitution as yet, owing to the scarcity of the stocks. It is a plant of spreading habit and strong growth, successfully resisting attacks of both phylloxera and chlorosis. We find that it grafts well, and is a suitable stock for dry and somewhat indifferent soils, and from the experience here it is decidedly promising. Its resistance to phylloxera is estimated at 18.

RUPESTRIS METALLICA.

Of this variety we have two strains, viz., those evolved by selection in France and Cape Colony respectively. The varietal name is an allusion to the metallic appearance of the foliage, which is very pronounced in some plants. Messrs. Dubois and Wyatt, formerly connected with viticultural work in this State, but now identified with the Agricultural Department, Cape Town, inform me that this stock is most extensively used in reconstitution at the Cape. Here we have found it a robust grower and a kindly graft-bearer, making excellent unions with the scion. It is a meritorious variety, since it resists drought well, succeeds in comparatively poor viticultural soils, and has a resistance of 18. Though included under Rupestris, it is considered by Foex, Viala, and others to be the result of a natural hybrid between Rupestris and Candicans.



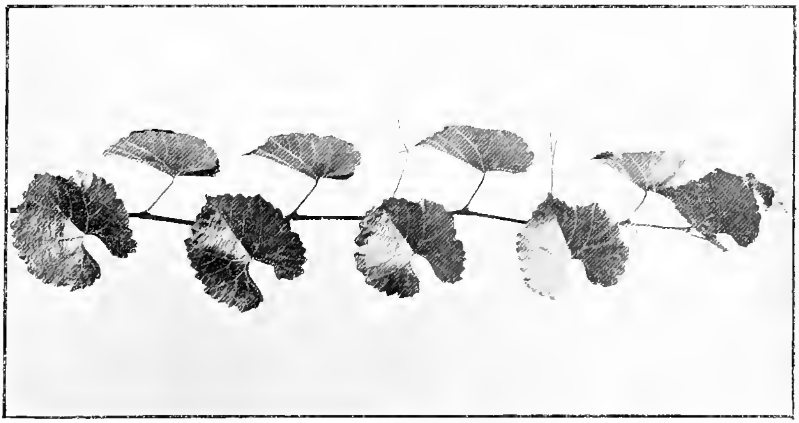
LEAF OF RUPESTRIS MISSION.



LEAF OF RUPESTRIS METALLICA.

RUPESTRIS DE FORTWORTH.

Fortworth, in Texas, near which it was originally found, gives its name to this variety. It is of remarkably vigorous growth, and produces



RUPESTRIS DE FORTWORTH.

with us canes of exceptional strength. The wood is hazel-coloured, showing a delicate bloom, and the young shoots and leaf-stalks are richly tinted with pink. The leaves are large, thick, and shining on both upper and under pages, the margins showing two series of indentations. Mr. Francois de Castella, of Château Dookie, has grown vines from seeds of this variety, imported by the late Baron von Mueller. The strain has been carefully selected, and at the writer's suggestion some of the vines have been planted in the midst of phylloxerated areas in various parts of the Goulburn Valley. These are still thriving, though all the surrounding European vines are either dying or dead. Further tests to decide its grafting affinity will be made when its resistance is as well established as its vigour. The strain selected in France has proved its resistance to phylloxera (18), as well as its value as a graft-bearer. R. du Lot, which adapts itself more readily than this variety to similar conditions of soil, is on the whole preferred in French reconstitution. The chief recommendation of R. de Fortworth is its phenomenal vigour.

THE FINING OF AUSTRALIAN WINES.

The word "fining," as applied to wines, means their clarification by the addition of a substance which, by precipitation, carries with it the impurities in the wine. As a substantive, "finings" is used to designate the substances used for this purpose. The derivation of the word is probably akin to refine, although as applied to wine, it was used to signify clear. In *The English Housewife*, published in 1631, is found, among other recipes, "Take a white wine hog's head, and put out the lees, and wash it cleane, and fill it halfe full and halfe a quarter, and put to it foure gallons of new milke, and beat it well with the whites of sixe egges, and fill it up with white wine and sacke and it will be white and fine."* In olden times the vintry received very great attention, and it is evident that the appearance of a wine was considered even before glassware was common. To come to the present day, appearance carries great weight, both with the purchaser and the consumer, and it is to the interest of growers to have their wines in brilliant condition as early as possible, so as to avoid dangers due to the foreign matters in suspension. It is a common reproach that the average Australian will not drink native wines, but in all fairness it must be conceded that they are not put before him as attractively as they might be. In the ordinary outlets, in hotels, restaurants, and the like, if we except a very few of the leading brands, how seldom is a really palatable table wine procurable. It is often placed on the table in an old beer bottle with a label that would be more appropriate on a sauce tin, and when opened found to be a viscous liquid, by no means attractive to the eye, and still less so to the palate. It is with the object of showing how this last condition should be improved that this article is intended, as well as to offer information of a precise nature which can be referred to in the cellar when required. The literature of wine making in the English language is very restricted, and is composed chiefly of translations from the French. So far, none of these have attempted to treat the subject of fining at any length. Even in the standard French works, the fining of wines is usually dismissed with a few paragraphs. The conditions here are very different to those in France, and in consequence French methods must receive considerable modification.

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* "The Flowing Bowl," by Edward Spencer.

Extracts have been made from the works of the following authors:—Coudon, Portes et Ruyssen, Bedel, Mathieu, Le Sourd, Féret, Coste-Floret, Viard Brunet, Pacottet, Laborde, and Carles. In making this acknowledgment, the writer wishes to point out that the tables comparing the various fining substances have been taken from Dr. Carles' *Le Collage des Vins*, an excellent little treatise on the fining of French wines, from which also much valuable information has been obtained.

Theory of Fining.

The introduction of a substance into wine, which is stirred so as to distribute the substance as evenly as possible through the liquid before it falls to the bottom of the vessel, carrying with it any impurities the wine contains, is the process commonly called fining a wine. The action is likened to that of a fisherman's casting net, which is drawn together to a small compass, bringing together all the small fish within its meshes. To get a clear idea of the clarifying action of a typical "finings," such as white of eggs when mixed with red wine, the most common wine treated, it is necessary to examine the principal elements entering into combination, and it will be noticed that the results of this operation are the consequences of two separate actions, the one chemical and the other mechanical. White of egg is formed by a salt, albuminate of soda, held in solution in water, and stored in tiny cells, formed by a very fine membrane, which also unites them*. Hence the reason why the white of an egg slips out in one piece when an egg is broken, and why it must be beaten up so as to mix with water, and why it becomes opalescent when, the cells being opened, the albuminate of soda is replaced by a liquid less adherent and more easily separated, such as water. It is necessary to remark that red wine always contains tannin associated with alcohol and various organic acids.

Chemical Action.

If this white of egg, beaten up with a little water, is put into direct contact with the wine to be fined, the albuminate of soda and the membrane which formed the cells in which it was originally imprisoned will act independently of one another. The first immediately decomposed by the acids of the wine will at once unite with the tannin to form a more or less spongy tannate. The membrane takes longer to unite with this same tannin, so that, if the quantity of tannin left in the wine in a free state were measured every few minutes, it would be found to be gradually diminishing. As soon as the quantity became constant, the membrane would be found to be saturated, or tanned, as a currier would say. While this saturation is taking place, and the albumin and tannin are combining to form an insoluble compound, the wine is thoroughly stirred and then left alone. It is necessary to remark that in order that this saturation should be complete, or, in other words, that the whole of the added finings become insoluble, the wine must contain sufficient tannin to saturate the whole of the added albumin. The chemical action reduces the quantity of tannin in the wine, which is advantageous in some cases, provided the reduction is not excessive. Reference to tables on page 239 will show to what extent the various fining substances may reduce the natural tannin in the wine.

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*Dr. Carles' "Le Collage des Vins."

Physical and Mechanical Action.

Stirring in the finings is with the object of bringing them in complete contact with the tannin, and hence assisting the coagulation of the albumin, and also to agglomerate the matters in suspension in the wine. The stirring particularly assists the coagulation of albuminous solutions when in liquids containing acids,† and when followed by complete rest, the albumin becoming saturated by the tannin increases in density, and as it becomes heavier it falls to the bottom of the cask. Under the continued influence of acids and alcohol, the tannate of albumin gradually hardens and contracts, and diminishes in volume, agglomerating the impurities in the wine with it, together with any ferments that may be present. However, isolated flakes may remain, which also fall to the bottom of the cask, carrying with them by adhesion any solid matters with which they may come in contact. This is somewhat analagous to snow-flakes, falling through the air, clearing it from dust, &c., as they fall. Consequently in the cask, with the albumin, a kind of filtration takes place, with the difference from ordinary filtration that the filter, tannate of albumin, passes through the liquid, while in ordinary filtering the liquid is passed through the filter. Tannate of gelatine in a pure state is not subject to decay, and it would seem that the longer it is left in the wine, the smaller would be the bulk of the precipitate or lees, the greater their density, and consequently the easier it would be to decant off the clear liquid from above them. Lees from finings are, however, subject to decay if (1) the finings have not been properly dissolved; or (2) if the quantity of added finings has been excessive. In the first case, the compound, which is not subject to decay, is found only on the outside of the particles of finings, the centre of which only contains albumin. In the second case, the albumin has not found sufficient tannin to form a non-putrefying compound, and is also subject to decay. The lees, however, contain all the impurities which it is desired to eliminate from the wine, particularly microbes and ferments. At a low temperature, when these latter are inactive, there may be no danger in prolonging the length of time in which the wine is left upon its lees, but in warm weather this would be most imprudent. The ferments are not dead, but only imprisoned in the finings, and, like all other living things, they give off gas, the bubbles of which may push up isolated flakes of finings, and so form floaters in the wine. There is also danger of the ferments escaping from their covering of finings, and affecting the liquid, more particularly when the weather is warm or unsettled. It is, therefore, advisable to rack the wine off the finings as soon as ever the desired degree of clarification is obtained. If the lees are at all voluminous they may be put into a heavily sulphured cask, and the clear liquid drawn off them in the course of a few days. The mechanical and physical action of the finings is due to the difference in density between it and the wine in which it is used. It is evident, then, that the greater the density of the wine, the less the difference between it and the finings, and consequently the more difficult it would be for complete precipitation to take place. It is for this reason that sweet wines are more difficult to clarify than dry wines by ordinary methods of fining.

Theory Applied.

From the foregoing brief examination of the theory of a typical fining operation it will be seen that the principle of the operation is based upon the chemical and physical action of albumin and tannin when brought into contact in the wine to be clarified. It would seem, therefore, that it is but a simple matter to obtain this desired clarification, but in reality that is not so. A wine, although apparently bright, may contain both albuminous matters as well as tannin in combination, if not in a state of solution, at any rate, in suspension. This apparent clearness may at any time be destroyed by some outside action, whereby the almost invisible particles become agglomerated, and a cloud is formed. This is particularly noticeable when wines are pasteurized, when, in some cases, they become cloudy, but clear again after complete rest, the action of the heat having agglomerated the particles in suspension. The action of cold has a similar effect, through precipitating the cream of tartar in the wine, which, as it falls, acts like a fining, carrying with all matters in suspension. The writer lately obtained a striking illustration of this action of prolonged cold in placing a hogshead of new red wine of 1904 vintage and a hogshead of new white wine of the same vintage in the Flinders-street cool stores. The wines were kept at a temperature of 35 deg. Fahr., and when racked, after four months' continued cold, were absolutely brilliant, and have remained so at ordinary temperatures. In all probability the clarifying action would have been found to be complete at the end of a few days. The most frequent cases of a wine apparently clear becoming cloudy again are when either there has been insufficient tannin to cause complete precipitation of the added finings, or that the wine was insufficiently oxidized prior to fining.* Theoretically, if the amount of tannin contained in a wine is known and found to be sufficient to precipitate a given quantity of albuminous or gelatinous finings, the addition of that exact quantity should cause clarification and the complete precipitation of all added finings.

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†Ramsden—Journal P. & C., 1895, p. 325.

In practice, on the contrary, it will be found that two wines containing an equal quantity of tannin will require a different quantity of added finings in order that clarification may be obtained. Dry red wines, as a rule, do not offer any difficulty in clarification. Clarets, as sold as such in Australia, may occasionally be difficult to fine, but the danger lies in fining very light wines in overdoing it and destroying their keeping qualities. It has been pointed out that the chemical action of fining reduced the amount of tannin naturally contained in the wine, and it is for the cellarman to determine whether or not the wine can afford this loss. In Australia, where most of our light wines come to rapid maturity, great care must be taken in their clarification, so that their keeping qualities are not in any way endangered. It is already noticeable that there are few very light red wines in Australia that improve with great age. Some of the very finest wines grown are at their best at three or four years, and even under. Only a few months ago it was the writer's privilege to taste a series of vintages in one cellar going back to the '70's, having lost character, colour, body, and flavour, and in some cases acquired flavours foreign to them. The exception was a very fine wine indeed, which the cellarman informed us was so rough that for years no one cared to drink it. It was just this excessive roughness that enabled this wine to reach a ripe old age full of charm and vigour, while its younger sisters were decrepit skeletons.

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* *Vide* "Clarification, &c., of White Wines," by J. Laborde, p. 5.

This may serve to illustrate the importance of not reducing this roughness, otherwise tannin, to any great extent in wines which it is intended to keep for any length of time. For wines intended for direct consumption it is another matter, but for the better class of wines, which may become, or, rather, are becoming more and more popular, care must be taken that sufficient tannin is left in the wine to insure its proper keeping qualities. In the face of the general opinion of the Australian public, as expressed by the class of wines they consume, this may be a somewhat difficult matter, as a rough wine is usually at once dismissed as too new. In time, no doubt, the consumer will gradually improve his palate so as to distinguish between a wine plentifully supplied with natural tannin and a new wine unfit for consumption. The same tendency towards wines deficient in acidity adds to the difficulty of manufacture and handling, without in any way improving the quality from a gastronomic point of view. With heavy full-bodied wines, it is quite otherwise. Their alcoholic strength gives them all the keeping quality desired, and consequently their tannin may be reduced, with but little possibility of any ill effect. It is questionable whether this argument applies to ports, which are always fortified. When fit for consumption, a port should be soft and smooth, and the tendency now is towards a pale coloured tawny wine. Where this desired colour is obtained by heavy finings with gelatine, the flavour and character of the wine is often affected, and the wine loses in value. It is noticeable that some Australian ports cease to improve with age, and in the writer's opinion it is in a measure due to a lack of tannin, which does not allow the wine the necessary chemical combinations which should produce the desired flavours to the fullest extent. With export wines, which have to stand the sea voyage, it is necessary that they should contain a considerable proportion of tannin, so as to land in good condition. The effect of the sea voyage is to render instable a proportion of the natural tannin, which is precipitated in the lees, and the wines often become used and worn, as though past their prime. The consumer requires a robust wine, with plenty of substance, and not a wine depleted of its natural flavour, and his wants must be considered. Under normal conditions a wine as it matures gradually loses a proportion of its natural tannin. The quantity is variable,* and it is practically impossible to estimate accurately what quantity of tannin a wine should contain so as to mature under the best possible conditions. Variations of soil and climate give results which are very different, and yet are not explained by analysis. Knowledge of local conditions, based on practical experience, shows the effect of certain methods of treatment, and the peculiarities of the wines so produced and handled. It is for the cellarman to study the peculiarities of his wines, and thereby obtain the necessary knowledge to modify his treatment, so as to obtain the desired result. No hard and fast rule can be laid down either in the choice of finings or in the quantity used, as in the same cellar the character and even composition of the wine varies in accordance with climatic conditions from year to year. We will now examine the various fining substances most in use, with a view to assisting the cellarman in his choice of both the material and the quantity required to obtain complete clarification.

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*White wines as a rule only contain traces of tannin.

A list of all the substances used for fining wines might be very extended but for actual requirements it may be confined to white of egg, isinglass, gelatine, lactocolle (casein of milk), and Spanish clay. If patent finings are not included in this list, it is because, in the writer's opinion, they should be classed in the same category as the mysterious compounds advertised in the French newspapers and catalogues, and said to improve the wines in which they are used. For instance, here is a "Regenerator for cloudy wines, giving them the elements indispensable to their preservation." The cost is, however, 5s. per hogshead, so that the inventor of the Regenerator is hardly a philanthropist. His compound may possibly be indispensable to the preservation of certain wines, but in all probability it could be obtained cheaper in its original elements. Patent finings may have advantages in being put up in a convenient form for use, but the purchaser usually pays for that convenience, more especially when the finings are sold in a liquid state. It does not follow that all patent finings, the actual composition of which is not shown, are pernicious, but it is not for the cellarman to use in his wine any finings containing chemicals which may be prohibited by the Board of Health. The ideal fining is one that will procure clarification at the smallest cost, without interfering with the composition of the wine, or leave any foreign matters in it. The cost is always a consideration, but the lowest priced finings are not of necessity the cheapest. The quantity used is variable, and, as a rule, the desired result is obtainable with a smaller quantity of the higher-priced finings than of those obtainable cheaply.

WHITE OF EGG.

The most popular of all finings for red wines, almost from time immemorial, has been white of egg. It is even mentioned by Palladius, and was probably in use among the ancient Romans. In all wine-making countries of the world, it is at the present day the commonest of wine finings. In the writer's opinion, eggs are less used in Australia than they should be, though the reason given that they are difficult to obtain when required, is, unfortunately, too often true. In the winter, particularly, eggs are often very scarce, and, as finings, it is essential that the eggs must be absolutely fresh. Each egg should be broken separately, and only the white used. The yolk contains fatty substances of no clarifying value, and not precipitated in the wine. The shell simply falls to the bottom of the cask, and, as it contains lime, may be attacked by the acids in the wine, giving off carbonic acid gas, which interferes with the precipitation of the lees. White of egg is an almost pure form of albumin, as will be seen by the following analyses:—

	Girardin (1).	Shutzemberger (2).
Water	86·34	82·88
Albumin	13·00	16·46
Mineral salts	·66	·66
	100·00	100·00

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1. Chimie Industrielle, p. 374.
2. Duclaux. Encyclopédie Chimique, p. 740.

According to Portes and Ruyssen (3), the albumin is composed as follows--

Carbon	53·33
Hydrogen	7·47
Nitrogen	15·5
Oxygen	23·7
	100·00

The average weight of the white of an egg is about 1½ oz. For clarifying ordinary wines the quantity varies between four and nine eggs per 60-gallon hogshead. It is generally used for red wines only, though the writer has used white of eggs for white wines with every success. Reference to Table II. will show that white of egg requires 1-32 of its weight of tannin to produce complete precipitation. If, then, the wine to be fined contains no superfluous tannin, an addition of tannin of about ¼-oz. per hogshead must be made if six eggs are to be used, that is taking each white to average 1½ oz. In practice, it will be found that white of egg precipitates very rapidly in red wines, leaving no foreign taste whatever, and making the wine clear and smooth, without inordinately reducing the natural tannin which it contains. This applies particularly in comparing the clarifying action of eggs with that of gelatine, as the white of egg is partly coagulated by the alcohol and acids contained in the wine, while gelatine is acted upon by the tannin only. For a light claret, an addition of 1-16 oz. of tannin per hogshead, followed by a fining with three eggs, will usually be found to cause complete and rapid clarification. The eggs should be beaten up well in a little water, a teacupful for every four eggs, each egg being examined separately, so as to insure it being fresh. When they are thoroughly beaten, they should be stirred into half a bucket of the wine to be fined, which is then stirred into the cask. Many authors advocate the use of salt in fining wines, particularly with eggs, as it is claimed that salt assists the dissolution of the albumin. This may be correct, but in practice the difference caused by the addition of salt is barely perceptible in ordinary circumstances. In view of the regulations of the Wine Adulteration Acts recently enforced in both Sydney and Melbourne, the addition of salt to finings cannot be recommended. It is not, of course, suggested that the addition of salt injures the wine, or is detrimental to health, but as this addition may serve to mask other adulterants, a limit has been very justly fixed, which, up till now, has not been exceeded by any Victorian wines analysed.

ISINGLASS.

After white of egg, isinglass is the purest substance used in wine making as finings. There are several varieties of diverse commercial value, according to the substance from which they are manufactured. The best quality is obtained from the bladder of the sturgeon, commonly found in the waters of the Black and Caspian Seas. Other qualities are obtained

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3. Traite de la vigne et de ses produits, Vol. II., p. 302.

from the bladders of other fishes, and an inferior quality is made by gelatinizing the flesh of certain fish, but it is of little value. The solubility of the best prepared isinglass varies between 98 per cent. and 89 per cent. at a temperature of 103 deg. Fahr. Reference to the tables will show that of all finings isinglass is the most readily affected by tannin. It impoverishes the wine to which it is added less than any other, and leaves less lees. For this reason it is more especially suitable for white wines. It has, however, the reproach of forming light lees and floaters in the wine. This is because isinglass is formed of fine membranes of varying consistency, which, during trituration, imprison tiny bubbles of air. These bubbles rise or fall in the wine, according to the difference in temperature, and more particularly according to the atmospheric pressure. This is a very serious difficulty in fining white wines for bottling for immediate consumption. The wine may be absolutely brilliant, except that it contains floaters, tiny particles like the grains of dust showing in a ray of sunlight in a room. To avoid this difficulty, special care must be given to the dissolution of the isinglass preparatory to using it as a fining. In the January number of the *Journal*, in a translation from the French[1], a short description of the method of preparing isinglass was given, which it would be as well to briefly repeat here. Soak the isinglass over night in cold water, and next morning take it from the water and work it into as smooth a paste as possible with a pestle and mortar, gradually diluting it with water (at a temperature not exceeding 110 deg. Fahr.), until it has the consistency of a thin paste. Then pass it through a fine sieve, so as to strain out the larger lumps, which are pounded up again before being added to the rest. To this paste add an equal quantity of warm water in which has been dissolved a quantity of tartaric acid, equivalent to 1-10 of the original dry weight of the isinglass. At the end of an hour or two the mixture will have become a clear jelly, and can then be used in the usual manner. This seems a somewhat tedious and lengthy process for ordinary cellar work, but the extra care is amply repaid by the increased effectiveness of the finings, and the avoidance of floaters, as referred to above. In dissolving both isinglass, lactocolle, and gelatine, the temperature of the water used is of first importance. If isinglass is boiled its clarifying action is almost completely destroyed. Instead of being readily acted on by the tannin, acids, and alcohol in the wine when mixed with it, the over-heating has already partially coagulated it, and it falls rapidly to the bottom of the cask in flakes, carrying with it only a minimum of the impurities in the wine. The above-mentioned method of dissolving isinglass is sometimes slightly modified by adding the tartaric acid while the isinglass is being pounded in the mortar. As, however, the action of the acid causes the isinglass to swell up, in my opinion it is preferable to make the addition after the isinglass has been pounded up and strained, and not before-hand. The isinglass referred to is that of commerce, sold usually in thin threads. The dried fish bladder is used by some cellarmen, but it requires a lot of labour to work it into a state fit for use, and it is only effective in the direct ratio to its division. When worked in a pestle and mortar, after having been chopped into small pieces, it takes a very long time before it can be passed through a sieve. For ordinary use, the isinglass, as prepared in threads and sold commercially, will be found in every way handier and particularly more easy to weigh accurately. The quantity of prepared isinglass necessary for finings is:—Light fining, $\frac{1}{4}$ oz. per hogshead; medium fining, $\frac{1}{2}$ oz per hogshead; heavy fining, $\frac{3}{4}$ oz. per hogshead.

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[1] J. Laborde. Clarification et limpidité des vins blancs.

Reference to the tables will show that, in round numbers, isinglass requires only one-quarter of its weight of tannin to precipitate it. In practice, with white wines, even this small proportion will only be found necessary as an addition in the case when the wine is absolutely deficient in tannin, or with greasy wines containing albuminous matters in suspension, which require an addition of tannin to precipitate them.

GELATINE.

Of all finings sold commercially, there is none with greater diversity of both appearance and actual value than gelatine. It is in reality only a purified form of glue, extracted from the bones, skins, and hoofs of animals. Sold in thin, transparent sheets, it is almost odourless, but when soaked in water, it has a distinct odour *sui generis*, which it may leave behind it in the wine, unless prepared with care. It is noticeable that the more opaque are the sheets or cakes the more distinct is this odour, and the smaller is the clarifying action. Many cellarmen prefer the dark coloured gelatine, sold in cakes, but, in the writer's opinion, it is only of value with coarse wines, the colour of which it is desired to reduce. Dr. Carles[1] is more emphatic in declaring that the whiter and more transparent the gelatine, the purer it is, and the more its action approaches that of white of egg and isinglass. This is also my opinion, from actual observation and experiment with Australian wines. Some authors[2] say that the whitest and most transparent gelatines do not clarify better than the darker coloured gelatines, which often have a repulsive odour. This is quite the contrary of my experience, and can probably be accounted for in the preparation of the gelatine, and the thin sheets being easily overheated. There is no doubt that the brownish matters which colour the dark gelatines are nothing but impurities. These gelatines also have a very strong action in reducing the colour of a wine, probably from their being obtained from bones, and, possibly, containing phosphates. One well-known author[3] absolutely condemns the use of gelatine as finings, and his argument really applies only to the very delicate wines of the country he writes of.

If prepared with care, and used in restricted quantities, gelatine is of great value as a clarifier of full-bodied wines, and also sweet wines. The leaves should be soaked in water over night, and the water poured away from them the next morning. This water will, as a rule, be found to have absorbed almost the whole of any unpleasant odour the gelatine may have contained. Fresh water should then be added in the proportion of from ten to twenty times the weight of dry gelatine. The whole should then be gradually and slowly heated until the gelatine is completely dissolved. It is preferable that this should be done in a water bath, to prevent the gelatine burning, and it is easily arranged by using a special pot

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(1) Le collage des vins.

(2) P. Pacottet. Vinification.

(3) E. Viard. Traité de la Vigne et du vin.

for the purpose fitted in a larger one containing water. In city cellars, where gas is available, this is an easy matter, but in the country, where open wood fires are used, care must be taken to avoid smoking the gelatine as it is being heated. As soon as the gelatine is dissolved, it should be mixed with a sufficient quantity of wine, to prevent its jellifying again, and then stirred into the casks. Some cellarmen prefer pouring hot water on the soaked gelatine, and gradually adding more hot water until the whole is dissolved. There is a danger with this, of burning the portion which comes in direct contact with the boiling water added, thus destroying its clarifying action, as referred to above. On the other hand, when the gelatine is gradually treated in the water bath, complete dissolution is obtained at the lowest possible temperature.

The quantity of the best quality sheet gelatine usually required for a fining varies between ½ oz. to 1½ oz. per hogshead. As it is precipitated by tannin only, reference to the tables is of special interest, as the figures are approximately accurate, while with all other albuminous finings the action of the acids and alcohol has to be considered. It will be seen that 10 parts of the best quality gelatine requires 7.68 parts of tannin to cause complete precipitation, and if the gelatine is of inferior quality, the proportion of tannin required may reach 12 parts to 10 of gelatine. The necessity of an addition of tannin is here evident in all cases, except with very rough wines, the astringency of which it is intended to reduce. With white wines deficient in tannin, an addition of tannin in the proportion of about 7½ parts to every 10 of gelatine will be found necessary to obtain complete precipitation.

LACTOCOLLE.

From the very earliest literature on wine making, milk has been favorably written of as a clarifier of wines. Its action is energetic, and it is cheap and easily obtainable, but, unfortunately, contains substances which are not precipitated, but remain in the wine, affecting its flavour and keeping qualities. For this reason, it has been very properly prohibited from use in wines by the Victorian Wine Adulteration Act. Recently it has been proved that it was only the albuminous substances in milk that had any clarifying action, and this albumin, called casein, has been largely prepared commercially. It has been named Lactocolle, and is obtained by chemically treating skimmed milk, and drying it on rollers similar to those used in paper mills. The result is a brilliantly white powder, odourless, with a very slight taste of milk. As finings lactocolle acts somewhat differently to others in that, although not itself alkaline, it is precipitated principally by the acids in the wine. It is evident that for this reason lactocolle should be of great value in over acid wines, but more especially in white wines. From the writer's experience, this claim has been somewhat modified in that, although lactocolle is undoubtedly precipitated in a liquid containing acids only, in liquids containing both tannin and acids the tannin greatly influences its precipitation. For instance, in the case of a light red wine containing a surplus acidity, if large quantities of lactocolle are used so as to reduce this acidity, the reduction is very slight, almost imperceptible in fact, so long as any tannin remains in the wine. The clarifying action of lactocolle is slower than that of most finings, but the lees formed from it are small and heavy, and, after bottling, no light deposit is formed. The chief difficulty with lactocolle lies in preparing it before adding it to the wine to be fined. Being an impalpable and very light powder, it does not mix at all readily with any liquid. The best method of obtaining dissolution is to gradually and slowly sift the powder upon about twenty times its weight of water, stirring slowly all the time. The water should be for preference tepid. If the water is added to the powder it forms a sticky and lumpy mass, very difficult to dissolve. When a thin paste is formed, it should be poured directly into the cask, and not first stirred into a bucket full of the wine, as is the case with other finings. The reason for this is not very clear, except that when mixed with a small quantity of wine, the paste seems to curdle slightly, while when gradually added to the bulk and well stirred, it forms a whitish cloud through the liquid, which slowly falls to the bottom, leaving the super nagent wine free from any foreign flavour. Were it not for this difficulty in dissolving it prior to adding it to the wine, lactocolle would have become more popular. I have lately tried leaving it mixed with the tepid water over night before using it, and the results seem a decided improvement upon adding it to the wine directly it is dissolved. The quantity to be used would vary between $\frac{1}{3}$ oz. and 1 oz. per hogshead. In the *Revue de Viticulture*[1] it is stated that 1 oz. of lactocolle is equivalent to the whites of seven eggs, and in practice it will be found that these proportions compare their clarifying actions fairly accurately, taking into consideration the difference in their chemical action when added to wine.

SPANISH CLAY.

The preceding fining substances have all a chemical action upon the wine to which they are added. They all reduce the wine in either its percentage of tannin, acidity, or both. Spanish clay is, on the contrary, purely mechanical in its action, in that it falls to the bottom of the cask, carrying with it, by adherence only, any foreign bodies with which it may come in contact. It is a greyish earth, used by porcelain makers, and is composed principally of silicates in a more or less pure state. It should be well washed, after being powdered as fine as possible, before adding to the wine. This clay is usually used in conjunction with other finings, and the quantity may be anything between $\frac{1}{2}$ lb. and 1 lb. per hogshead, and even more. Its action following gelatine is often useful.

TANNIN.

Although tannin was not included in the list of finings, and may not, strictly speaking, be included, as such its action is so involved with the chemical action of finings that in most cases no proper clarification can be obtained without it. Commercial tannin is obtained principally from oak galls, formed by the action of certain insects upon the leaves of the tree. Tannin is present in varying proportion in all wines. At the ripening of the grapes it is condensed in the stalk, skin, and seeds. As this tannin is soluble, whatever may be the method of wine making, no wine is absolutely free from it. Both the quantity, and the fixity of that quantity, are variable, and have a tendency to diminish. The more the wine is deprived from contact with the stalk, skins, and seeds, the less tannin it will contain. Of the tannin found in new wine, one portion is precipitated by the albuminous substances in the first lees, another by the colouring matter, and a

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(1) A. Muntz. Revue de Viticulture, No. 420.

third portion is rendered insoluble by the oxidizing action of the air. The natural loss of tannin, even in new red wines, is so very great that the quantity remaining in the wine is often insufficient to permit a fining with any gelatinous or albuminous finings. This lack of sufficient tannin is the chief cause of defective clarification, and the logical remedy, however obvious, is too often disregarded in Victoria. The addition of tannin to a wine introduces no persistent foreign substance. If a quantity of tannin is added prior to fining, sufficient to combine with the finings used, as the tables below explain, the most scrupulous analysis, or the most delicate palate cannot find after the operation any trace of added tannin or finings. All the natural tannin will have been left intact, and all the finings added will have been precipitated only by the exact quantity that was added.

Commercial tannin is sold in various forms, of which alcoholized tannin is the purest for wine-making purposes. It is usually found as a whitish yellow powder. This powder dissolves slowly in cold water, making the liquid cloudy, but it clears when treated, and remains clear. It dissolves very rapidly in spirit. It has always been the practice of the writer to dissolve a known quantity of tannin in weak spirit, the quantity of which is measured, and then can be bottled and used as required. For instance, if 1 lb. of tannin is dissolved in 1 quart of spirit, $\frac{1}{4}$ of a pint of the solution contains 2 ozs. of tannin. Tannin is obtainable commercially of excellent quality, and if exceptions have been taken to peculiar odours found in wines after an addition of tannin, it has usually been when small quantities have been obtained from the local chemist, who has not always the space to keep his stock separated, and the tannin has absorbed the odours from adjacent chemicals.

Tables showing the coagulating action of tannin in combination with various finings:—

TABLE I.

1 Part of pure alcoholized tannin precipitates—

Skimmed milk	52·00	parts
Fresh white of egg	32·00	,,
Prepared isinglass (dissolved cold) ...	4·07	,,
Dried white of egg	3·20	,,
Lactocolle	3·29	,,
Prepared isinglass (dissolved hot) ...	2·60	,,
Best quality gelatine	1·30	,,
Common isinglass	1·04	,,
Cake gelatines	·94 to ·83	,,

TABLE II.

			Tannin.
10	parts of	skimmed milk precipitate	0·19
10	,,	fresh white of egg precipitate	0·30
10	,,	prepared isinglass (dissolved cold) precipitate	2·68
10	,,	dried white of egg precipitate	3·12
10	,,	lactocolle precipitate	3·04
10	,,	prepared isinglass (dissolved hot) precipitate	3·84
10	,,	best quality gelatine precipitate	7·68
10	,,	common isinglass precipitate	9·61
10	,,	cake gelatines precipitate ...	10·50 to 12·00

Choice of Finings.

As has been stated already, it is impossible to lay down any hard and fast rule to fix the amount of finings necessary to obtain clarification. Figures have been given to indicate the quantities likely to be found necessary, and should be varied by experience in local conditions, and the requirements of the market for which the wine is intended. Cellarmen are proverbially conservative, and when able to obtain clarification with a finings with which they are familiar, are not usually anxious to change their methods. It is not the intention of the writer to advocate changes of method where the result obtained is satisfactory, but rather to afford information with a view to assisting the cellarman to fix upon a fining suited to his local conditions. It is just this knowledge of local conditions which is all important in the successful handling of wines. The cellarman should watch most carefully the development of his wines, noting carefully what improvement he can make in this development by actual experience. It is not by merely rule-of-thumb methods that the best results can be obtained. Care must be taken in the measurement of the finings used, as it is only by accurate measurement that practical information can be obtained. Under modern conditions any saving that can be effected in the cost of handling wines is of as much importance as the necessity of obtaining rapid and complete clarification. By accurately measuring his finings, and carefully noting the effects of varying quantities, the cellarman is enabled to obtain clarification at the lowest possible cost consistent with the result desired to be obtained. It does not always follow that the best result can be obtained from the cheapest-priced finings, which emphasizes the economic necessity for accurate measurement and careful observation. The clarification by fining of the dry red wines of the Murray Valley, which form the backbone of the Victorian export trade, seldom offers any difficulty. Heavy wines, full of substance and body, they are able to stand a heavy fining, and be improved by it. Gelatine is the most popular of finings for this class of wine, but, in the writer's opinion, eggs are infinitely preferable when available. Lactocolle has been found to give satisfactory results, especially in young wines. If an improvement can be made on gelatine in fining the dry red wines of the Murray Valley, the same argument must apply, even more forcibly, for the dry red wines of the Upper and Lower Goulburn. Many of the heavy burgundies of the Dookie district seem to lose their colour very rapidly with age, and no fining should therefore be used which would materially hasten this natural loss of colour. In the Lower Goulburn Valley district, many dry red wines become rapidly worn and attenuated as they mature. This is usually due to a natural abundance of albuminous matters precipitating the tannin in the first lees. The choice of finings should here be restricted to those which reduce the natural tannin the least. In all cases where dry red wines have to be fined prior to export, the reduction of tannin must be carefully considered, as the effect of shipment is towards hastening this reduction, and there is a danger of the wines being found worn upon arrival in London. With the clarets of the Lilydale and Great Western districts, which are usually marketed in bottle for local consumption, their natural delicacy precludes any heavy fining. As they are often only consumed at a considerable age, care must be taken to in no way interfere with their keeping qualities, so that they may attain the fullest possible development of their natural bouquet and flavour. With light white wines the best fining is isinglass, and if care be taken in its preparation, complete clarification should always be obtained. As white wines are generally deficient in tannin, an addition of this substance is almost always necessary, prior to the addition of the finings. Many white wines are difficult to clarify, and therefore require special care in handling. Where this difficulty is usual, it has been the writer's experience that it can be largely overcome by an addition of tannin at the time of fermentation, so that the bulk of the impurities are precipitated in the first lees. As soon as fermentation is complete, the wine will be found to take a fining readily, and remain permanently bright. For sweet wines generally gelatine is commonly used, and if tannin is used in the proportions indicated in the preceding pages, even with very sweet wines, Spanish clay will seldom be found necessary. It is usual to apply a much heavier fining to sweet wines than to dry wines, and if gelatine is the substance used, it is evident that an addition of tannin must be necessary to insure complete precipitation of the gelatine. It will be found that an addition of tannin, just prior to fining, cuts down the finings rapidly, as the added tannin, being in a free state, immediately combines with the finings, causing their complete precipitation.

When to Fine.

As a general rule, whenever a wine is not absolutely bright, it should be at once clarified. The cloudiness is either due to organic matters in suspension, albuminous substances in pseudo-solution, or germs of alcoholic or microbian fermentation. In each case the cloudiness is made up of what may be termed impurities, which should be eradicated as soon as possible. There is nothing to justify the old method to wait until a wine is old enough to fine, as the longer a wine is left in contact with impurities, the greater is the danger of those impurities deteriorating the quality of the wine. As soon as ever fermentation is complete, if a wine does not clear naturally means must be taken to obtain clarification at once. If this method were more generally practised there would be less faulty wine offered for sale than there is at present. Often wines are found to go off as soon as the temperature of the cellar rises with the first heat of the summer. Usually this is due to the wines containing germs of disease which develop as the temperature rises. If these wines had been thoroughly clarified during the winter following the vintage, the germs would have been precipitated while in a dormant state, and would not have been present in the wine to become active as the increased temperature favoured their development. Sulphuring prior to fining should always be practised when fining young wines, so as to prevent any fermentation, which might prevent the finings falling rapidly. With wines about to be bottled, even if bright, a fining is often necessary, so that there should be no excessive sediment deposited in the bottle, which may redissolve in the wine as a bottle is shaken. Appearance goes for so much, that every care should be taken to please the eye of the consumer. If the writer is criticised for continually suggesting that great care must be taken, the excuse is that it is only with the most scrupulous and careful methods that the best results can be obtained. Cellar work is too often allowed to get behind hand while other work is finished. The handling of wines is becoming, with keen competition, an operation which must take precedence of all others on the vineyard. The grower's stock of wine for the year represents his previous year's labour, and should consequently receive all necessary attention, as that attention is required. Frequently we are told that the racking will be done as soon as the pruning is finished, or that the grower means to fine his wines as soon as as he has finished ploughing. The cellar, on the contrary, should receive the first attention. Diseases and defects in wines should be prevented rather than be allowed to develop, and then some attempt made to cure them. It is only by providing for possible deterioration, by treating defects in their incipient stages, that losses are to be avoided. The great argument in favour of the most modern cellar methods is that losses by disease are reduced to a minimum. The chief object of pasteurizing wines is to destroy any germs of disease which they may contain, and so insure them against subsequent loss. As wines have to be clarified before they are pasteurized, the arguments used in favour of clarifying young wines still apply. Foreign writers almost invariably advise that fine weather and a high barometer should be chosen for fining wines. For very light delicate wines the weather certainly has a considerable effect, and when wines are about to be bottled changes in the atmospheric pressure may cause the lees to rise. In most instances, however, if the above-mentioned cases be excepted, with the wines of this country, which are very much heavier than those to which foreign writers allude, the weather is not a very serious consideration.

How to Fine.

The cellarman, having determined upon the special variety of fining he intends to use, must measure out the desired quantity, and set about dissolving it, as described in the preceding article. Supposing that there are twelve hogsheads of dry red wine to be fined, and that the cellarman has decided upon a fining with 1 oz. of gelatine per hogshead, he measures out 12 ozs. of gelatine, which are soaked in cold water over night. Next morning the cold water is poured off, and fresh water added, and the gelatine is dissolved by gradual heat. As soon as dissolution is complete the warm finings are poured into, say, three-parts of a bucket of the wine to be fined, a sufficient quantity to keep the finings liquid

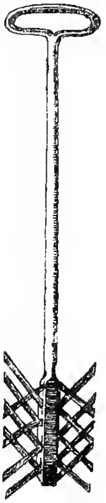


FIG. 1.

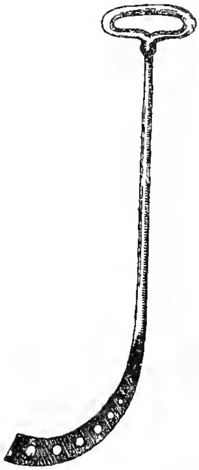


FIG. 2.

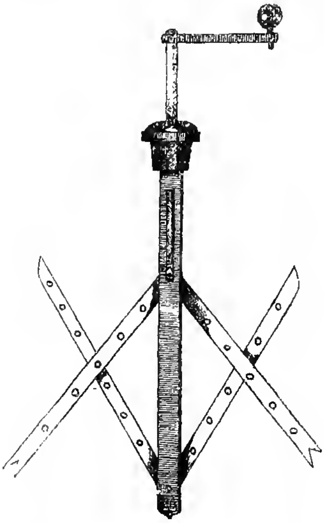


FIG. 3.

when cold. This bucket of finings, mixed with wine, is divided into twelve parts, one part therefore representing 1 oz. of gelatine. As fast as the wine is racked into clean and sulphured casks, one-twelfth part of the mixed finings is stirred into a bucket of wine, and thoroughly stirred in the hogshead. To effect this stirring, many contrivances are used. In the Bordeaux district of France, a fining brush (Fig. 1) is used, made of galvanized steel from 3 to 4 feet long, and with pig's bristles from 4 to 6 inches long let into the end, which goes into the cask. The loop handle is fully wide enough for the hand to enter freely. The cellarman, holding his hand palm uppermost, describes a circle, bringing his hand towards him, and turning his wrist, completing the circle palm downwards. As soon as his hand reaches the point from which he started, he strikes hard in the opposite direction, thereby breaking the current set up by the previous motion. The knack of using this brush can be easily acquired by practice, and in my opinion is the most rapid method of stirring finings. Some cellarmen favour the Burgundy rod (Fig. 2), shaped like a hockey stick, and used somewhat similarly to the brush, but with a thrusting downward stroke. To those unacquainted with the use of either of these implements, various mechanical appliances are available. Fig. 3 shows a steel stirrer, of which the handle is attached to a rod moving in a perpendicular slide. When the rod is pushed downwards, as in the drawing, the wings on either side expand, and are drawn together again as the rod is drawn up, so as to allow them to pass through the bung-hole. Figs. 4 and 5 show another appliance arranged so that when the two handles are opened, the two semicircular steel plates are brought together. Figs. 6 and 7 show a contrivance with bevelled gearing. The little pieces of steel attached to the main rod fly out as the rod is turned, setting up a considerable current in the cask. Whichever system is used, it is necessary to stir in the finings, so that they mix completely with the wine. It is erroneous to suppose that if the finings are stirred into the surface only of the wine, that they will clarify the whole of the liquid as they fall.

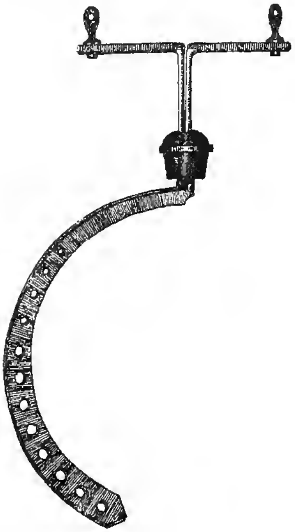


FIG. 4.

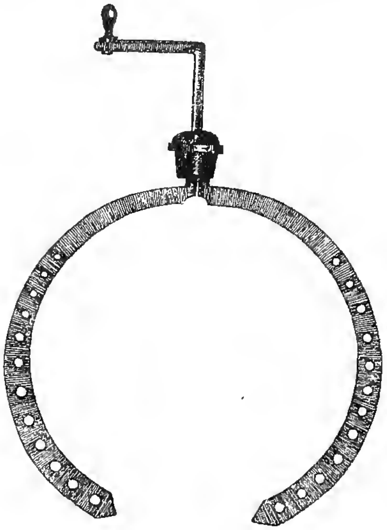


FIG. 5.

As soon as the finings are thoroughly stirred into the hogshead, the cask should be carefully filled and tightly bunged. The froth formed by the stirring must not be allowed to prevent the cask being completely filled, as any scum of finings left on the wood near the bung-hole of an incompletely filled cask is liable to decompose and taint the wine. If the froth flows over the bung-hole it must be washed off clean, and the bung-hole also wiped clean before the cask is bunged up. It is always preferable to use small casks for fining wines, as the smaller the volume of the liquid, the more rapidly and completely will the finings precipitate. If possible, a set of hogsheads, or puncheons, should be set apart specially in which to fine wines, and each cask fitted with a top plug, so as to facilitate racking. If the top hole is bored slightly on one side of the cask, that is to say, not directly under the bung-hole, the casks can be stacked bung sideways, which obviates any necessity for filling up until the wine is ready to rack off the finings. The only disadvantage of this method is that there is a difficulty in drawing samples, so as to know exactly when the wine becomes bright. In large cellars it is sometimes found impossible to confine the clarification by finings to small casks. Under these circumstances, to accurately measure the finings, and mix them thoroughly and rapidly with a large volume of wine, the best method is as follows:—

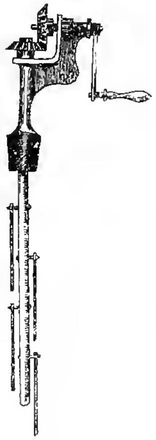


FIG 6.

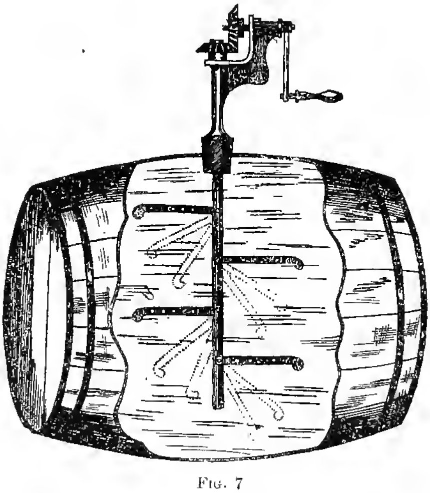


FIG. 7

Place two hogsheads, or puncheons, above the level of the top of the casks to be fined. In most cellars, where an upper story is not available, a temporary platform can easily be erected on the top of conveniently situated storage casks, as in Fig. 8. The wine is pumped into one of the hogsheads, and as soon as it is almost full, the finings are stirred in as in the former case. Then, as the second cask is being pumped full, the first cask can be siphoned down into the empty storage cask ready to receive it. By this means, the quantity of finings can be accurately measured and completely mixed with the volume of wine to be treated. Two men working with thousand-gallon casks, can rack and fine easily 3,000 gallons per diem. When large casks are used, special care must be taken to prevent any possibility of the wine moving or fermenting while on finings, as the length of time which must elapse before the wine becomes bright is very considerably more than in the case of hogsheads. As a rule, a wine fined in hogsheads should be fit to rack off the finings within ten days, while with thousand-gallon casks the time may extend to six weeks, and even two months. When wines are fined, so as to prepare them for bottling, it is not advisable to bottle them directly off the finings. Although the wine may be quite brilliant, there is a danger of traces of the finings being carried into the bottles. Small quantities, imperceptible both to the eye and the palate, are sufficient to cause a non-adherent deposit in the bottle, which is mixed up in the wine with the slightest movement of the bottle, depreciating the value of the wine to the consumer. Several writers have noticed the influence of oxygen upon the precipitating of finings. There are sometimes certain tannates of albumin which are held in pseudo-solution in the wine, and are precipitated when the wine is oxidized during bottling. To avoid this danger, it is preferable to rack the wine off finings, and give it complete rest for a month or more before bottling.

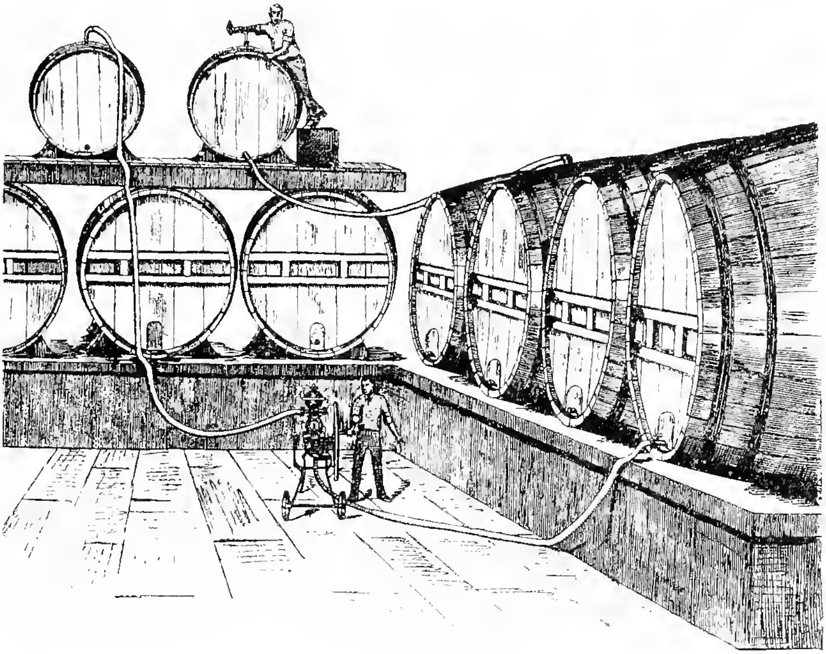


FIG. 8.

Unsuccessful Fining.

It sometimes occurs that the fining operation, as described above, is not successful, and the wine remains cloudy, or, after becoming bright, soon turns cloudy again. The causes lie either in the defective preparation of the finings, a lack of tannin, or a microbian or alcoholic fermentation. It may also occur through the quantity of added finings being excessive, but this is at once noticeable to the palate. Presuming that the cellarman has dissolved his finings, as already indicated in this article, and has previously added tannin in sufficient proportion to insure the complete precipitation of the added finings, a persistent cloud must be due either to the quantity of finings used being insufficient, the wine being insufficiently oxidized to permit complete precipitation of the finings, or else to some form of fermentation. As a rule, these first two causes of failure are sufficiently obvious, and are simply remedied. The last case is the most troublesome, as it may mean that the wine will rapidly deteriorate. As soon as a wine shows any sign of disease, the first remedy is a moderate to heavy fining. If this fining does not take, the wine must be at once racked into sulphured casks, and fined again. Sulphurous acid is the only antiseptic permitted in cellar work, and is almost always sufficiently powerful to temporarily check all fermentation until clarification is obtained.

The Effects of Fining.

It will be seen from the foregoing remarks that the first effect of fining is a partial sterilization. By the use of sulphur, the germs and ferments are temporarily rendered inactive, and are carried out of the wine into the lees. What great value must, therefore, be pasteurization, which completely destroys all the germs in the wine. As a both scientific and practical method of handling wines, pasteurization will undoubtedly become a popular treatment in all properly equipped modern cellars. It is, however, necessary that the wine should be bright prior to pasteurization, as the heating is liable to fix some of the solid matters in suspension, making their precipitation most difficult. Filtering may have, in this case, certain advantages over fining wines as a means of obtaining sufficient clarification to allow pasteurization, which, however, should be followed by a fining, so as to carry into the lees all the germs killed by the heating process. The effect of a properly conducted fining does not alter the flavour of a wine, but, by eliminating impurities, gives a greater delicacy to that flavour. Coarse rough wines are obviously improved by fining, which decreases the roughness by reducing the tannin. A wine is thus softened by this treatment, and acquires a velvety smoothness obtainable by no other method. As the process of fining requires no expensive machinery, it is practicable even in the most primitively appointed cellar, and, intelligently applied, can be of the greatest possible assistance to the wine-maker in enabling him to obtain the degree of clarification necessary to insure the proper development and profitable handling of his wines.

CHAPTER XIII.

FEEDING OF FARM ANIMALS.

In feeding live stock there are few farmers in the State who have as yet turned their attention to the question of the best combination of available foodstuffs. Yet there is no doubt of the economy of doing so. We do not mean that the precise weight of each kind of food can be determined by experiment. There is always the difference between individual animals to be taken into account, and the success of the stock-owner is largely dependent on his taking notice of these differences. But over and above all else there are certain laws in the economy of animals which must be recognised, if success is to be achieved.

For it must be remembered that the animal body is like a machine in this respect, that it is able only to transform the food materials into other forms of energy or into different chemical substances. It is no more able to create within itself the power of doing work or of secreting milk than a steam engine can keep on running when not supplied with wood and water. The food of the steam engine consists simply of carbon and water. That of the animal is more complicated. Water and carbon it must have in abundance, but the carbon is useless for the purposes of life in the form of charcoal. It requires to have been first of all worked up by plants into the form of starch and sugar, or of oils and fats. But the animal differs totally from the steam engine in this respect. Not only must it have the foods already mentioned, but others still more costly and complicated must be provided. This class of foods is called *protein* or *albumin*, and is found to consist of not only carbon and water, but also of nitrogen and traces of phosphorus and sulphur.

Chemical Composition of Foods.

Wherever life of any kind exists, whether it be in the form of plants or animals, the above classes of chemical substances are always found. However different a plant may be from an animal the difference is due to the varying distribution of these materials, rather than to the presence of any distinctive substance in either plant or animal. Speaking roughly, plants are distinguished by the preponderance of carbon, animals by the relative amount of protein.

Carbon forms the charcoal of the plant. It exists in the form of wood and fibrous materials, as starch and sugar (carbohydrates), and as oils and fats. Wood and fibre are generally too tough for the animal to digest and utilize as food, but the carbohydrates and fats form most important articles of food. They serve as fuel for the body, keeping up its warmth, and supplying it with much of the material for doing work. In the case of the cow they furnish a large part of the solids of the milk. For these purposes any given quantity of fat has a food value of two and a half times the same weight of carbohydrate. This fact explains the instinctive liking that all animals have for fatty foods in cold weather. The sugars, starch, and oils are found most abundantly in seeds and fruit, but reference to the table which follows shows that they are present in all parts of the plant.

Protein consists not only of carbon and water, but also contains nitrogen, and traces of phosphorus, sulphur, potash, and many of the inorganic salts. Its distinctive feature is the nitrogen which it contains. Protein is the essential part of all living substances, and it is for its replenishment that nitrates, ammonia, sulphates, and phosphates are required in manures. Nitrogen exists in nature chiefly in the form of the gas which constitutes four-fifths of the atmosphere. But with some few but very important exceptions, plants are not able to make use of it in this form. They require to have it presented to their rootlets in such form as nitrates or ammonia salts dissolved in the water of the soil. The plant stores the nitrogen chiefly in the seed, and thus in the form of protein it becomes available as food for animals. The white of egg, lean meat, and the casein of the milk are examples of nearly pure protein. Blood, muscles, nerves, and organs not only consist largely of protein, but they require this same substance, or others very like it, as food to make good the wear and tear of daily life, and to provide for growth and development. Hence protein is an essential part of the food of all animals. The plant, under the influence of the heat of the sun, slowly and laboriously manufactures it from the soil; animals eagerly appropriate it from the plant or else from one another, so that the struggle for existence has been well described as "the struggle for nitrogen." Every moment the living parts of our bodies are being worn out and renewed, and this renewal can only be effected by protein in the food. Protein is therefore an essential part of every ration, and from what has been said it will be seen that it is the scarcest and most costly part of every ration.

But while the chemical composition of the food is thus fixed there is another point of supreme importance. The food must not only have the right constituents, but it must also be digestible and palatable. The mere taking of food into the stomach is not sufficient to sustain life. The juices secreted by the walls of that organ must act on it, and reduce it to such a condition that the solid parts become dissolved and are thus able to permeate the walls of the stomach and intestines and enter the blood. By the blood they are carried to all parts of the body to supply the food required by the working parts. The food must therefore contain a proper proportion of digestible matter. When the stomach is filled with a mass of dry, hard, innutritious grass, leaves and straw, not only is the animal deprived of proper nutriment, but it cannot make use of the digestible parts of that which is actually present in the stomach.

Then also the food must be varied in character and appetizing. We all know the effect upon ourselves of the way in which a meal is cooked and served, and the same holds good for all animals. The sight and smell of food, and the anticipated enjoyment of the meal are the chief stimulants to the secretion of the gastric juice. It has been shown by recent experiments that suitable food may be placed in the stomach of a starving animal, and no attempt will be made to digest it if the animal is not aware of its presence. In the same way the digestive juices will be secreted in abundance if the animal merely *thinks* he has swallowed food. He may be completely deceived on this point, but preparations for the digestion of the meal are made all the same. Hence successful feeding implies variety as well as quantity and quality.

Relative Value of Foodstuffs.

A knowledge of the chemical composition of any food is not of itself sufficient to enable us to estimate its value to the animal. We require to know in addition how much of each "nutrient"—the name given to the nutritive parts of the food, including protein, fat, carbohydrates, and mineral matters—is digestible or available for the purposes of the animal economy. The following table has been copied from Bulletin 132 of the Agricultural Experiment Station of the University of California; and the requisite analyses have been carried out, partly at the laboratory of that University and are partly derived from Henry on "Foods and Feeding." The climatic conditions make the results obtained in California more directly applicable to Victoria than those derived from Europe or the Eastern States of America. The *nutritive ratio* gives the proportion which the protein bears to the weight of the carbohydrates and fats combined, 1 lb. of fat being calculated as equivalent to 2·5 lbs. of sugar, starch, or gum. For instance, let us take green lucerne. Taking the figures from the table the nutritive ratio is calculated as follows:—

Percentage of carbohydrates	7·30
Add food value of fats, ·6 × 2·5 ... ... =	1·50
Total	8·80

Divide 8·80 by the percentage of protein, viz., 3·7, and the quotient is 2·37.

And the decimal may be carried to any desired degree of accuracy. Hence the nutritive ratio of green lucerne is said to be 2·3, that is, it contains one part of digestible protein to about two and a third parts of all the available non-nitrogenous constituents. This is an example of a "narrow" ration, because the nitrogen is large in proportion to the total of all the digestible nutrients. On the other hand, potatoes are an example of a "wide" ration, because the protein is small in proportion to the other nutrients (1 to 18·4).

Dry Matter and Digestible Nutriments in 100 lbs.

Feed Stuffs.	Dry Matter in 100 lbs.	Digestible Nutrients in 100 lbs.			Nutritive Ratio.
		Protein.	Carbo-hydrates.	Fat.	
Green Fodder.					
Lucerne	20·0	3·7	7·3	·6	1 2·3
Saltbush	23·5	2·5	9·2	·3	1 3·9
Barley	21·0	1·9	10·2	·4	1 · 5·8
Red Clover	29·2	2·9	14·8	·7	1 . 5·7
Maize	20·7	1·0	11·6	·4	1 · 12·6
Cow Pea	16·4	1·8	8·7	·2	1 : 5·1
Horse Bean	15·8	2·2	7·1	·2	1 : 3·4
Oats	37·8	2·6	18·9	1·0	1 · 8·2
Orchard Grass	27·0	1·5	11·4	·5	1 : 8·4
Rye	23·4	2·1	14·1	·4	1 . 7·2
Soya Bean	24·9	3·2	11·0	·5	1 : 3·8
Sorghum	20·6	·6	12·2	·4	1 : 22·0

DRY MATTER AND DIGESTIBLE NUTRIENTS IN 100 LBS.—*continued.*

Feed Stuffs.	Dry Matter in 100 lbs.	Digestible Nutrients in 100 lbs.			Nutritive Ratio.
		Protein.	Carbo-hydrates.	Fat.	
Roots, &c.					
Beet, sugar	15·7	1·6	11·9	·1	1 : 7·6
Cabbage	15·3	1·8	8·2	·4	1 : 5·1
Carrots	11·4	·8	7·8	·2	1 : 10·3
Mangels	9·1	1·1	5·4	·1	1 : 5·1
Parsnips	11·7	1·6	11·2	·2	1 : 7·3
Potatoes	21·1	·9	16·3	·1	1 : 18·4
Pumpkins	9·1	1·0	5·8	·3	1 : 6·6
Turnips	9·5	1·0	7·2	·2	1 : 7·7
Hay.					
Lucerne	89·1	12·3	37·1	1·6	1 : 3·3
Barley	91·5	5·8	43·1	1·6	1 : 8·1
Clover, red	84·7	6·8	35·8	1·7	1 : 5·8
Cow Pea	89·3	10·8	38·6	1·1	1 : 4·6
Oat	89·9	4·5	43·7	1·5	1 : 10·5
Rye Grass	86·0	6·1	37·8	1·2	1 : 6·6
Vetch	88·7	12·9	37·5	1·4	1 : 3·1
Wheat	91·2	3·6	46·1	1·1	1 : 13·5
Straw.					
Barley	85·8	·7	41·2	·6	1 : 61·0
Oat	90·8	1·2	38·6	·8	1 : 33·8
Soya Bean	89·6	2·3	40·0	1·1	1 : 18·5
Wheat	90·4	·4	36·3	·4	1 : 93·0
Grain and Seeds.					
Barley	90·0	9·6	63·5	2·1	1 : 7·1
Maize	89·4	7·8	66·7	4·3	1 : 9·9
Cow Pea	85·2	18·3	54·2	1·1	1 : 3·1
Oats	89·0	9·2	47·3	4·2	1 : 6·2
Rice	87·7	5·3	67·6	·3	1 : 12·9
Soya Bean	89·2	29·6	22·3	14·4	1 : 1·9
Sunflower	92·5	12·1	20·8	29·0	1 : 7·7
Wheat, old	91·7	13·7	47·6	1·4	1 : 3·7
Products.					
Brewers' Grains (wet)	24·3	3·9	9·3	1·4	1 : 3·2
Cocoanut Oil Cake	85·9	16.4	42·4	9·7	1 : 4·0
Maize Meal	88·0	6·4	66·3	3·4	1 : 11·6
Linseed Meal	89·1	26·1	38·5	6·5	1 : 2·0
Pea Meal	89·5	16·8	51·8	·7	1 : 3·2
Peanut Meal	89·3	42·9	22·8	6·9	1 : 0·9
Wheat Bran	88·3	11·2	42·2	2·5	1 : 4·3
Pollard	88·3	12·2	53·4	3·8	1 : 5·1
Silage.					
Californian Analyses (1)—					
Barley	26	1·8	12·7	0·9	1 : 8·3
Clover	28	2	13·6	1·0	1 : 8·0
Maize	25	1·3	13·5	0·6	1 : 11·5
Oat	28	1·5	14·8	0·9	1 : 11·5
Orchard Grass	23	1·1	10·6	1·0	1 : 11·9

DRY MATTER AND DIGESTIBLE NUTRIENTS IN 100 LBS.—*continued.*

Feed Stuffs.	Dry Matter in 100 lbs.	Digestible Nutrients in 100 lbs.			Nutritive Ratio.
		Protein.	Carbo-hydrates.	Fat.	
Average American Analyses (2)—					
Maize	21	0·9	11·3	0·7	1 : 14·5
Sorghum	24	0·6	14·9	0·2	1 : 25·6
Lucerne	28	3·0	8·5	1·9	1 4·4
Grass	32	1·9	13·4	1·6	1 : 9·1
Maize and Sorghum ..	24	1·6	13	0·7	1 9·2
Victorian Analyses, 1903 (3)					
Maize, No. 1 ..	25	1	14·6	0·8	1 : 16·6
,, ,, 2 ..	20	0·9	10	0·9	1 : 13·6
,, ,, 3 ..	19	0·9	9·6	0·8	1 : 12·8
,, ,, 4 ..	20	1	10·5	0·8	1 : 12·5
,, ,, 5 ..	18	0·7	5·3	0·4	1 : 9·0
Sorghum	22	1·2	11·3	1·3	1 : 12·1
Maize (nearly ripe) ..	40	1·4	25	0·9	1 : 19·4
Grass	35	1·8	21	1·2	1 : 13·3
Oats and Clover ..	28	2·3	14	1·2	1 . 7·3
Oats, 1905 ..	34	2·2	18	1·0	1 · 9·3

(1) University of California, Bull. 132.
(2) Henry, p. 243.
(3) Chemical Lab. Dept. of Agriculture.—In calculating the digestible nutrients from the total amount of each constituent present, I have averaged the co-efficients of digestion.—T.C.

The foregoing table should be kept for reference, as it gives the relative nutritive values of most of the foodstuffs commonly used in this State. Various rules have been adopted for calculating the commercial value of any given material. None of these are quite satisfactory, but a fair comparison may usually be made by reckoning the protein as worth twice as much as the carbohydrates, and the fats as worth from two and a half to three times the carbohydrates. Take the following examples from the table:—

OATS.

Protein—9·2 × 2 ... ... = 18·4
Carbohydrates ... . = 47·3
Fats—4·2 × 3 ... ... = 12·6

Total ... ... 78·3

BRAN.

Protein—11·2 × 2 ... ... = 22·4
Carbohydrates ... ... = 42·2
Fats—2·5 × 3 ... ... = 7·5

Total ... ... 72·1

Hence, 72 lbs. of oats are worth as much money as 78 lbs. of bran. In other words, allowing for the difference in weight of the respective bushels, when bran is at 1s. oats are worth 2s. 2d. the bushel. As a matter of fact, the market value of oats is always somewhat higher on account of their special value as horse-feed.

Value of Protein.

The value of protein as the necessary food for keeping up all the living tissues of an animal has been already explained. The most difficult problem of both feeding cattle and raising crops is to keep up the supply of this all-essential nitrogenous food. It will be seen that of green fodders the various legumes, as lucerne, clovers, peas, and beans stand pre-eminent, while the large amount which saltbush contains explains at once the high value of this as a forage plant. All the root crops are relatively poor in protein, while ensilage and hay correspond to the greenstuff from which they are made, but in hay the percentage is relatively high, because the dry matter has been increased by the disappearance of 60 per cent. of the water. As the crop ripens the protein is rapidly concentrated in the seeds, and hence the richness of grain and the poverty of straw. Here again the quantity of protein attains a maximum in peas and beans. The high food value of the various by-products is explained by a glance at the table.

FEEDING RATIONS FOR COWS.

The quality and quantity of food supplied to our dairy cattle has, up to the present, been left too much to chance. When the seasons are favorable no better food can be found than the natural pasture grasses, but these require to be regularly supplemented. No fact has been more clearly demonstrated than that the yield of milk and butter fat is dependent on the food supply. This, of course, is what one would expect, since the first use of the food is to keep the animal alive, and it is only the surplus of the ration that the cow can turn into milk. Taking 1,000 lbs. as the standard weight of a cow, it is found that to maintain the full milking capacity the following average ration is required:—

Dry matter in food	25 lbs.
Containing Digestible Protein	2·5 lbs.
〃 〃 Carbohydrates	12·5 lbs.
〃 〃 Fats	·5 lbs.

together with at least 75 lbs. (7½ gallons) of water and a little salt. In hot weather the water requires to be greatly increased. The amount of dry matter in the form of coarse fodder should be about 16 lbs., and the quantities should be so adjusted that the nutritive ratio is 1:6·5. In other words, cows do not yield their best if fed on too coarse or too concentrated foods. If we turn to the table it will be seen that all the above requirements are contained in about 80 lbs. of fresh red clover, or in 100 lbs. of good rich mixed pasture grasses. To supply the difference between the above standard quantities and the amount that the cows actually obtain is the problem which has to be faced by the dairying industry in Victoria.

Let us see how the full ration may be supplied, supposing the cows are wholly hand-fed, and always keeping in mind the fact that variety of food and a palatable mixture are essential.

I.

lbs.	Dry Matter.	Protein.	Carbo-hydrates.	Fats.
10 Lucerne Hay	8·9	1·23	3·7	·16
10 Oat Straw	9·8	·12	3·8	·08
20 Mangels	1·8	·22	1·1	·02
4 Oats	3·5	·37	1·8	·17
4 Bran	3·5	·45	1·7	·10
	27·5	2·39	12·1	·53

lbs.	Dry Matter.	Protein.	Carbo-hydrates.	Fats.
II.				
12 Lucerne Hay	10·68	1·48	4·46	·18
40 Maize Silage	10·00	·50	5.39	·22
4 Bran	3·53	·45	1.69	·10
	24·21	2·43	11·54	·50
III.				
25 Lucerne	5·00	·74	1·4	·12
14 Oaten Hay	12·80	·65	6·2	·21
20 Maize Silage	5·00	·25	2·7	·11
4 Bran	3·53	·45	1·7	·10
	26·33	2·09	12·0	·54
IV.				
40 Mangels	3·6	·44	2·2	·02
18 Oat Hay	16·2	·80	7·8	·26
3 Linseed Cake	2·6	·78	1·1	·20
3 Bran	2·6	·34	1·2	·08
	25·0	2·36	12·3	·56

It will be seen that in all cases the difficulty is to provide the requisite amount of protein without unduly increasing the bulk of the ration and the amount of carbohydrates; hence the use of bran and other concentrated foods.

In order to see how the food each cow is receiving actually compares with the amount given in these rations, the food should be carefully weighed. The nutritive value of each kind may then be calculated from the table, and tabulated in the form of the preceding rations. The question should then be asked—Is the cow picking up enough grass in the paddocks to make up the deficiency? If not, the ration should be brought up to the standard, and the increase in the milk noted. The point where judgment is necessary is in valuing the food that the animal obtains while grazing. The appetite of the cow is usually a pretty safe guide as to when she has not had enough.

The Horse.

The chief points with regard to the feeding of horses are mentioned in the following chapter. Speaking generally, working and riding horses are much more liberally provided with the flesh-forming constituents of food than is the case with the cow. Oats and hay are cheap and plentiful, and every one knows how quickly hard fare tells on these animals. The chief distinction between the horse and ruminants is the comparatively small size of the stomach and intestines, and the way the horse can live and thrive on dry food. These peculiarities are related not only to the teeth, but also to the hoofs of the two animals, the solid hoof of the horse corresponding with the firm ground and dry vegetation of his native uplands in Central and Western Asia. The food of the horse must, therefore, be more concentrated than that of the cow. There must be less bulk, and grain may form as much as half the ration, or even more.

The balanced daily ration for horses at hard work per 1,000 lbs. live weight should weigh from 30 to 35 lbs., representing 25 lbs. or more of dry substance. The nutritive ratio is from 1:6 to 1:7. This may be made up as follows, the nutritive ratio being 1:7 :—

	Dry Matter.	Proteid.	Carbo-Hydrates.	Fat.
17 lbs. oaten chaff ...	15	·75	7	.2
13 lbs. oats	11	1.2	6	·5
4 lbs. bran ...	3	·45	2	.1
34	29	2.4	15	.8

The Paris Omnibus Company keep 13,000 horses on a ration consisting of about 8 lbs. each of oats, hay and straw with 11 lbs. maize with ocassionally a little bean meal or bran. The ration of the horses in the German Army consists of 11 lbs. oats, 5½ lbs. hay, and 7½ lbs. straw.

While oats is the best and favorite grain, barley, maize, bran, peas and beans may all be used in suitable proportions to form the grain portion of the ration. Lucerne hay is unrivalled for the horse, as for other kinds of live stock, while an occasional bite of green fodder, ensilage, or roots is very beneficial.

SHEEP.

Sheep are at present so seldom fed by hand that the question of rations need hardly be discussed. As in all other cases, the growing animal needs more protein than is necessary when maturity is reached, and the nutriment ratio varies from 1 : 5 for 35 lbs. lambs, to 1 : 8 for full-grown sheep. The results of extended observation show that while sheep may be made to eat anything by pressure of hunger, still they naturally exhibit marked preferences and thrive best when they have feeding conditions which they appreciate. Thus fattening lambs show much better results when allowed access to pastures in addition to a paddock of rape, than when confined to rape alone, and in all cases they should be allowed space enough so that they are not compelled to eat materials that have been soiled with their own excreta.

The most important fact for the northern farmer to grasp is the need ewes have of succulent food, in order to keep up the milk supply of the lamb. This is a physiological necessity—normal quantities of milk cannot be secreted from dry food alone, and the lamb cannot thrive and grow rapidly unless he has the milk. As explained later on in this chapter, a few hundred tons of wild oats and self-sown crop made into silage by modern methods will make the farmer independent of early autumn rains. A mixture of peas and barley grows well throughout the winter in all parts of the State. It matures early enough to be less dependent than oats or wheat on the spring rains, and the peas by their deep roots and faculty of gathering nitrogen from the atmosphere have a most beneficial effect on the land. The faster a lamb can be made to reach 40 lbs. in weight the more profitable it is, and it may be safely asserted that the full profit can only be realized when the mother has a good flow of milk. Rape and Swedes may usually be grown for use in the latter half of the year, but these go to seed as the hot weather approaches. No method except silage can be used to secure succulent food from January to May.

PIGS.

These animals almost invariably are fed on a ration that is too bulky in proportion to the amount of nutriment it contains. Pigs compelled to produce the greater part of the increase in weight by a mixture of skim milk and grass do not make sufficient headway to be profitable stock, unless the grazing is lucerne or clover. These are more valuable on account of the quantity of protein which they contain. No ordinary food is so valuable as skim milk or butter milk, but these should be used to supplement—not to replace—more solid foodstuffs. It is found that skim milk gives the best results when it is fed in the proportion of not more than three pounds to one pound of grain (barley, peas, maize or pollard). The nutritive ratio should be about 1 in 7, and as the pig is the animal which makes the quickest gains and produces the largest proportion of dry material in the carcase, it follows that every effort should be made to keep them growing continuously. Of the grain in use, pollard with peas and barley are the favorites, except in the maize districts; and the figures at the foot of page 174 show the immense numbers of these animals that are raised principally off this crop. While there is a larger proportion of fat in the pig than in any of the other domestic animals, it has been abundantly proved that a fair proportion of protein is economical from the food point of view.

MODERN SILAGE METHODS.

The object in making silage is to preserve the green fodder in the same condition as it was when cut in the field. In hay making the preservation is secured by drying all the moisture out; and while this method supplies a marketable and easily-handled material, it has the disadvantage of sacrificing all the natural juices of the food. It is all important to recognise the fact that water cannot replace the natural juices. Hence any means by which the green fodder can be preserved in the succulent condition is well worth the attention of the farmer. Speaking generally, in all parts of Victoria it is the absence of green food which is severely felt every year, and which practically limits the stock-carrying capacity of every farm. In periods of prolonged drought dry food itself may run short, and the animals suffer from actual starvation; but, for the most part, the remains of last season's herbage, along with hay and straw, supply enough dry material if only there is a little succulent juicy food to supplement it. These considerations apply especially to animals which chew the cud. Their teeth and digestive apparatus are formed to deal with food in a soft and bulky condition. The cow cannot yield milk, or the bullock continue steadily to gain in weight, if fed exclusively on dry food. In many districts the success of the lambing season is closely dependent on the early autumn rains providing a new growth of grass. Animals of all kinds are at their best during October and November, and if there is any easy way in which the conditions which obtain during these months can be perpetuated from one year's end to the other, there is no question but that the number of live stock of all kinds in the State could at once be more than doubled. Modern silage methods place this within the power of every farmer if combined with the cultivation of suitable crops to fill the silo. Even without any extra cultivation much can be done with what at present is, to a large extent, wasted. In the north there is often abundance of trefoil, barley grass and other herbage beginning to dry up by the end of October. A couple of hundred acres of wild oats and self-sown wheat is of little value, even if made into hay; while if made into silage it would provide abundance of the right kind of food for the autumn. In the south, maize and amber cane mature faster than they can be profitably fed as green fodder. In hay making districts part of the crop might with advantage be made into silage. It is by the combination of dry and succulent food that the largest amount of nutriment is extracted from both. Other advantages which silage has when compared with hay will be discussed later on.

The Causes of Former Failures.

Silage has been tried by a few farmers for the past twenty years, but up to the present it has never been extensively adopted. There is no district where it is in general use. In most cases the stack and pit have been used with a certain amount of success, but very few farmers make it regularly year by year. On the other hand, the silage "boom" which is now taking place in America is the most noticeable event in recent agricultural practice. Not only is the silo spreading in all parts of the United States, but the men who have had most experience of silage are the most enthusiastic about it. The number of the silos on progressive farms steadily and rapidly increases from year to year, while the size has increased from 50 to 500 tons. It is evident, therefore, that with American methods there is no uncertainty either with regard to the quality of the silage or with regard to the feeding results that attend its use.

When green stuff of any kind is put together in a heap a rise of temperature ensues. This rise of temperature is due at first to the vital activity of the green plants, the cells of which are not yet dead. But if the heat is present for several days it shows that further changes of the nature of fermentation and putrefaction are occurring. In all cases the heat shows that combustion of some kind is taking place, and it is unfortunately a fact that the material which first disappears from the silage by this combustion is the sugar and other easily digested food substances in the crop. The more heat therefore the worse the quality of the silage. The heating, however, can only occur if air is present, for oxygen from the atmosphere is absolutely necessary to keep up combustion of any kind. Hence the key to the production of first-class silage is the complete exclusion of the air. To make any kind of green stuff settle down in a firm and solid mass, it requires to be chaffed. Pressure alone is not sufficient to squeeze all the air out of the interstices of the leaves, and from the interior of the stalk. The saving in food material which is effected when no rise of temperature takes place, is far more than enough to pay for the extra trouble involved. Good silage pays better than inferior silage from any point of view. The more readily air can gain access, the greater will be the destruction of food material. Hence the inside of the silo must be perfectly airtight and smooth, and without corners, so as to allow the material to settle uniformly without obstruction. A deep silo is therefore better than a shallow one, and round is a better shape than square or rectangular. If these conditions are fulfilled the silo may be above or under ground, and there is no uncertainty as to the result. In 1886 Gilbert and Lawes pointed out the necessity for excluding the air, and the consequent advantages of first chaffing the green fodder. Unfortunately many farmers concluded that because cattle readily eat the black stinking silage which results from overheating, it is only necessary to make any kind of stack or pit. Some have even gone so far astray as to declare that the higher the temperature the better will be the results. The truth is that if it were possible to absolutely prevent any rise of temperature from taking place the green fodder would come out of the silo in precisely the same condition as it was when cut in the field. The more nearly one can approximate to these conditions the better will be the result.

To obtain the best possible results we require therefore (1) to cut the crop up small, so as to allow it to be pressed into a solid mass; (2) to have the silo air-tight; (3) to have it built so as to offer no obstruction to the uniform settling of the silage. It will be seen at once that the stack fulfils none of these conditions, and except to meet a temporary emergency it should not be entertained. The objection sometimes raised to the labour involved in chaffing the green stuff is not borne out by experience. The green crop passes through the ordinary chaffcutter very easily, and the real labour is found to be the haulage of the heavy material from the paddock. Provided there is good provision against water entering the silo, it does not matter whether the silo is above or below ground. It is simply a question of convenience in handling the silage, and of economy in the cost of construction. The shape should always be circular, and the height should be as great as possible. A few years ago 15 or 20 feet was the usual height in America; now it often exceeds 40 feet. It is found that the greater the depth of silage the less is the waste, and the more uniform the quality.

One great advantage of the deep silo is that less weighting is required after the silo is filled. The chaff is trodden down firmly as the filling proceeds, and it will be found that very little settlement subsequently takes place. A layer of mould forms on the top, and the surface foot gets fairly warm. Beneath this there is hardly any warmth at all, and the silage is of uniform quality from the centre to the outside walls. When it is decided to commence feeding from the silo, the layer of moulds is removed, and 2 or 3 inches of the silage raked off the surface daily. A series of port-holes is made on one side, so that the material may be lowered by a canvas or wooden shoot into the dray or truck below. The diameter of the silo should be proportional to the number of animals, so that the surface can be kept fresh so long as feeding continues. Silage made in one of these silos keeps good for an indefinite number of years, or, on the other hand, feeding may begin at once, as soon as the silo is filled.

Various Forms of Silos.

In suitable localities a pit may be simply dug out of the ground, the earth from the excavation being used to increase the height of the walls. It should be circular, the walls perpendicular, and the inside finished with a perfectly smooth face. Occasionally this may be done by plastering up all the inequalities with clay alone. Usually, however, it is necessary to line the pit with brick or concrete, and finish with a coat of cement. The overground part may be built of brick, stone, or concrete. The walls should be 9 inches thick for the first 12 feet *from the top* of the silo, 18 inches for the second 12 feet, and so on, the inside face is kept plumb, and the walls strengthened by building in hoop-iron or several strands of wire. Any buttresses must be on the outside. Ample time must be allowed for the walls to set before they are filled for the first time. Silos built in this way are more expensive as to first cost, but they are practically indestructible.

In America the stave silo is the favorite, but it is not so well adapted to our requirements on account of the way our hard woods shrink and warp as they dry. If built of 2-in. oregon or red wood, the cost is very much greater than the frame silo built in the way described below. The hoops for the stave silo are made of $\frac{3}{4}$-in. round iron, and lugs and nuts are arranged the same as those of a cyanide vat, so that the staves may be tightened up from time to time.

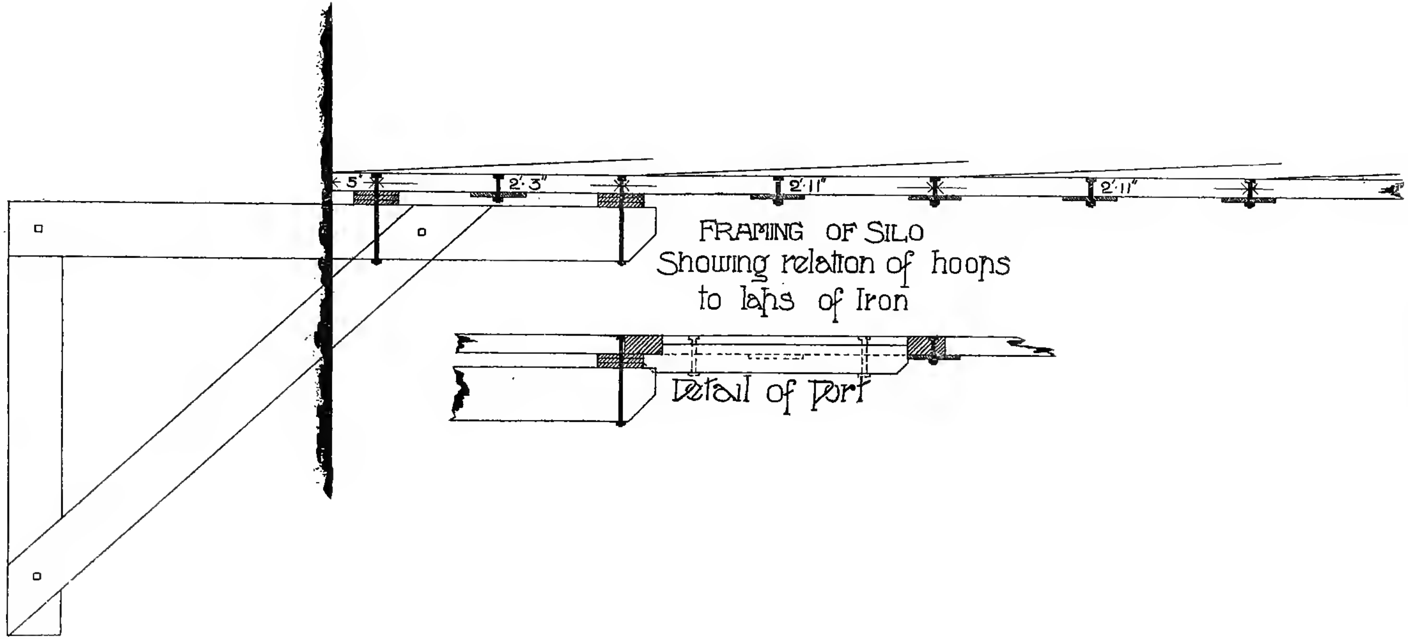
In building a wooden silo, it must be remembered that the internal pressure on the walls before the silage sets amounts to about 350 lbs. to the square foot at a depth of 26 feet. Hence the framing must be rigid and very strong. The only way in which this can be secured is by building it on the same principle as the cask. The wood or iron bands corresponding to the hoops are made of a thickness to correspond with the size of the silo. Square buildings usually bulge at the sides or crack at the corners. The wood silo may be erected on a brick foundation, the latter extending 6 feet, or deeper, into the ground. On page 263 are examples of this class of silo.

Probably the most satisfactory method, giving the best possible results as far as quality of the silage is concerned, and reducing the cost of construction to the minimum, is to build the silo above ground, making the frame and hoops of hardwood, and the lining of plain iron. Twenty-four gauge galvanized iron is the best for this purpose, but black iron, coated with tar or anti-corrosive paint on both sides, will last a lifetime. In all cases, the inside receives a coat of limewash immediately before filling, to neutralize any acid that may be formed by the silage.

How to Build an Overground Silo.

The following considerations are to be borne in mind:—

1. The foundation must be firm enough to secure the silo when empty against the force of the wind.
2. The woodwork close to the ground must be protected against dry rot and white ants.
3. The material for the hoops requires to be straight grained, and free from knots and gum veins. A long lap is made at each splice, and bolts used so as to avoid splitting the timber.
4. The iron lining requires to have a lap of about 3 inches at the joints. If the clout nails are not more than 4 inches apart, the lining alone will be strong enough to take the pressure of the silage. The nails must be in the centre-line both of the lap and of the stud.



MATERIALS FOR SILO, 15 FEET DIAMETER, 21 FEET HIGH.

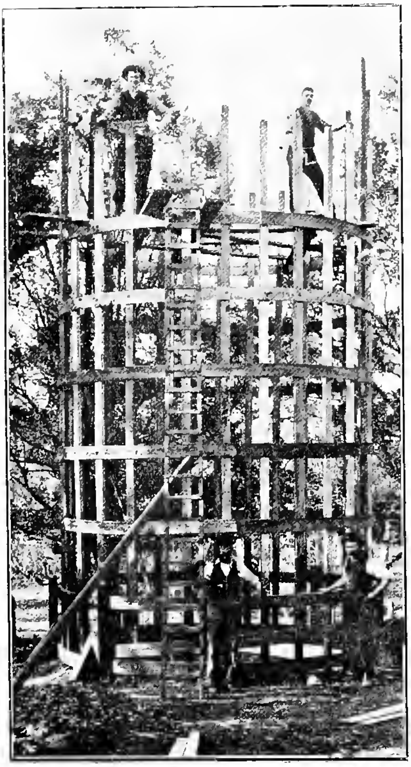
6 x 4 Redgum, 8/6, 8/5, 8/4.
4 x 2 Hardwood, 27/21, 6/24, 1/20, 6/16.
3 x 1 , 2/12.
6 x 1 ,, 4/11
6 x $\frac{1}{2}$,, 60/18.
8 6 x $\frac{1}{2}$ Bolts, Nuts, and Washers.

16 9 x $\frac{1}{2}$ Bolts, Nuts, and Washers.
16 8 x $\frac{3}{8}$,, ,, ,,
250 3 x $\frac{3}{8}$,, ,, ,,
100 4 x $\frac{3}{8}$,, ,, ,,
56 sheets 6 x 3 x 24 G. plain Galvanized iron.
16/8 sheets Corrugated Galvanized iron.

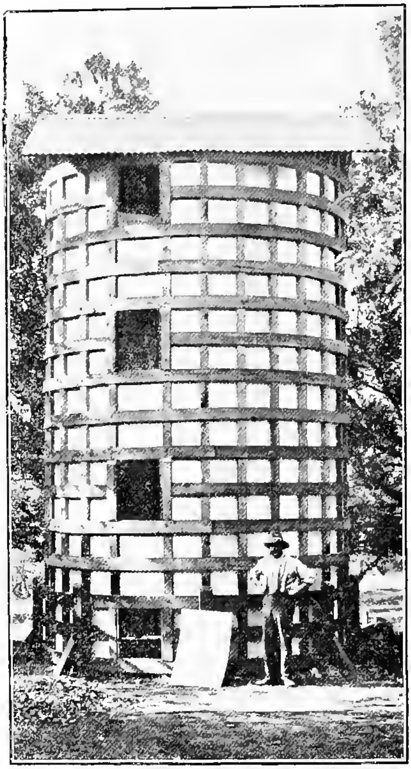
3 lengths 14" ridging.
2 lbs. springhead nails.
20 lbs. assorted wire nails, mostly 2".
20 lbs. 1" clouts.
2 lbs. Tinsmiths' rivets.
4 gallons tar or elastic carbon paint.

Specifications for Silo 14 feet 8 inches inside Diameter and 21 feet High.

All the materials used are to be of approved quality and the best of their kind. The timber to be specially free from knots and gum veins. The foundation posts, bottom hoops, and the bottom 3 feet of the studs to be tarred before fixing.



FRAME IN COURSE OF ERECTION.



SILO COMPLETE.

THE FOUNDATION.—Prepare eight foundation posts (6 x 4 redgum), as shown in sketch. Bolt the sole and post together edgeways, and halve the strut in both post and sole. Secure with ½ inch bolts. Fix a peg in centre of site, and with a trammel 7 feet 8 inches in length describe a circle. Dig for, and, when in position, fill in and well ram the posts 3 feet in the ground and 3 feet out of it, so that the inside face of each post is true to the end of the trammel. From the centre line of this face to the same line in the next post is 5 feet 10 inches, measured straight. Be careful to keep the inside face of each post exactly perpendicular. Make a composite curved plate by nailing three of the 6 x ½ boards to the inside of the posts, carefully springing the first of them to the circle described by the trammel. Make butt joints, and let each successive hoop break joints. This hoop should be kept at least an inch from the ground. They require for the present only to be lightly nailed together, as they will be bolted to the posts in the way to be described below. A similar triple hoop is fixed, so that its upper edge is 35 inches from the ground. These two curved plates are used to fix studs in upright position safely.

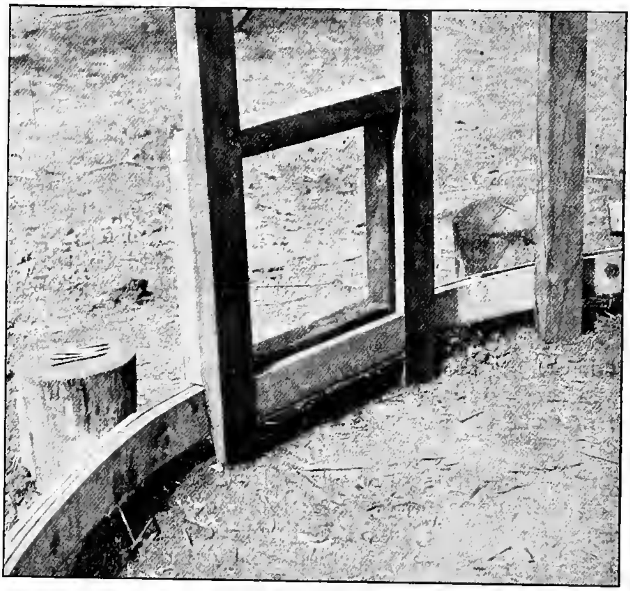
THE FRAMING.—The framing is made of 4 x 2 hardwood studs, placed sideways on the inside of the hoops. They are marked and bored for the ⅜ bolts before fixing. The ends are kept an inch off the ground. Every fourth stud comes opposite one of the posts, and these are bolted with 8 x ⅜ bolts passing right through the posts and studs. The intermediate ones are bolted with 4 x ⅜ bolts to the curved plates. In all cases, keep the nuts on the outside of the silo, so that they may be tightened as the hardwood shrinks. The spaces between the studs (except the pair which take the port-holes) are 13⅛ clear, measured on the inside edge of studs. A sheet of iron should be tried against every fourth stud, so as to see that the lap is correct. The hoops are 17½ inches apart, centre to centre. The upper hoops are marked as to the line at which they will cross each stud before they are fixed, so that the diameter of the silo remains the same all the way up. This is done by first bending them round the outside of the circle of studs at 3 feet from the ground, and marking the position of each stud on the hoop. (Of course the hoop must be fixed to the stud from which it was marked.) The lap of the two boards forming the hoops should be from 24 inches to 30 inches, according to the quality of the timber, so as to more than cross two adjacent studs. Bolts are passed through these studs and both hoops, as shown in Fig. 5; ⅜ bolts to be used to secure the hoops at every alternate stud. If the end of a hoop is cracked, bolt over the lap a fishing piece to cover three studs. The studs are kept plumb as the hoops are fixed. The first one to be erected should be one of the sides of the port holes.

THE LINING.—Twenty-four gauge galvanized iron is used. The lap is 3 inches on the studs, and one inch top and bottom. Press the sheets out to the line of the circle before nailing; 1 inch or 1¼ inch clout tacks are used, 3 inches apart along the lap, and 6 inches apart on the other studs. Three tinsmiths' rivets to be used between each stud to secure the horizontal lap. The edge of the lower sheet in each lap is *inside* the upper sheet, so as to exclude the weather.

THE ROOF.—Construct roof by bolting three 16 feet 4 x 2 purlins to the top of the studs of each half of the silo, allowing a pitch of about 3 feet to the ridge. Use 24 feet studs for the purpose of carrying the purlins, placing them in the circle where directed. Cover the roof with 8 feet corrugated iron 26 gauge, allowing one and a half corrugations lap, with spring-head nails at every third corrugation. Provide and fix three lengths of G.I. ridging 14 inch.

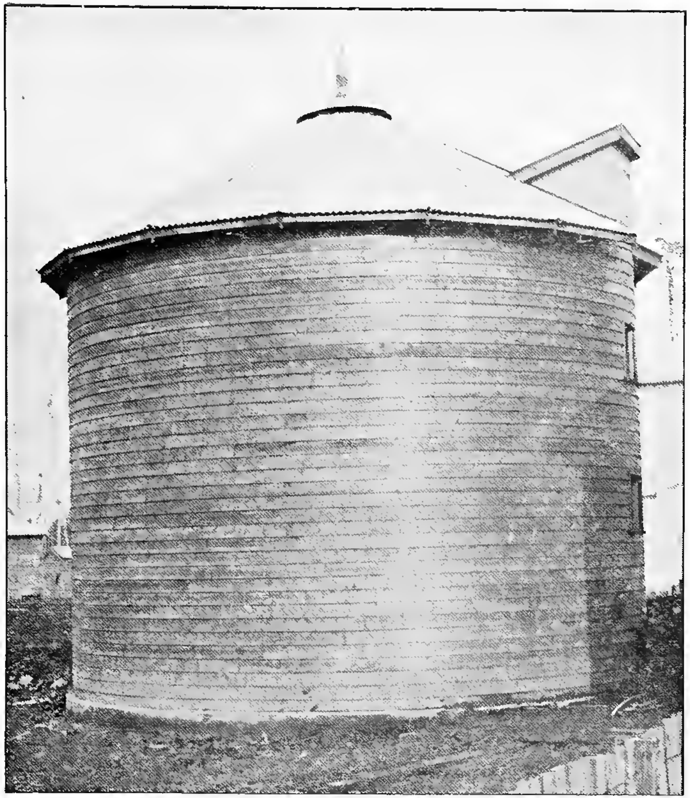
THE PORT HOLES.—The space between the last stud and the one first erected is made 22 inches clear. This makes the space between the last and the last but one less than 13 inches. A port is made in every second row of iron, the sill of the first one being 3 feet from the ground. The sill and lintel are made of 4 x 2, the top of the sill being ~~flush with~~
1 in. above

the top of the hoop. The studs are backed up on their outer surface between the sill and lintel by pieces of 4 x 2, which are notched to cover the ends of the hoop corresponding to the middle of the port, and the whole secured with $\frac{3}{8}$ bolts. The sill is nailed to the inside of the hoop so that it is flush with the studs on the inside. The stops are 3 x 1, set 1 inch back from the inside face. The rectangular piece cut from the corresponding sheet of iron is backed up with three or four pieces of 6 x 1, each 22 inches long, so that they fit close against the stops. The iron sheet then laps 1 inch or more all round the inside, and the pressure of the silage keeps the door against the stops. The doors are placed into position as the silo is filled, and they are knocked back into the silo as each becomes exposed, as the silage is emptied from the top. Short lengths of 4 x 2 studs may be placed between each lintel and the sill above, to support the iron lining.

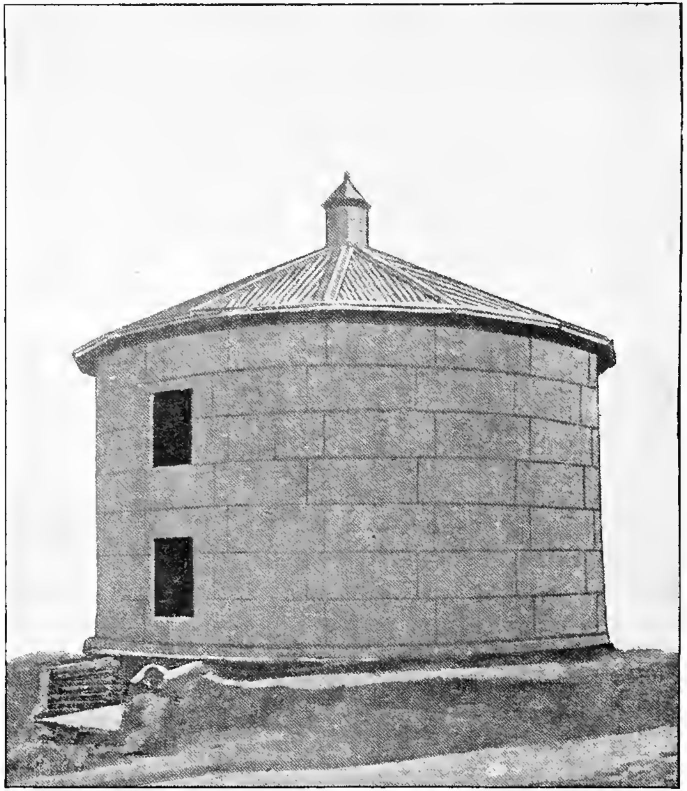


PORT HOLE, FRAME SEEN FROM INSIDE OF SILO.

ROOF.—The roof may be left until the silo has been filled, as the silage forms a good scaffold to work from. The easiest method is to thatch it with straw, a few light saplings being laid across on top of the uppermost hoop, the straw thrown on top of them, well topped at the centre, and secured by a few strands of fencing wire from side to side. Another method is to make a low-pitched roof, as in the specification. The gable takes the head of the elevator. This roof may be covered with iron, paling, or ruberoid. The circular conical roof looks best, and is easily made. A light frame is secured to the tops of every third stud, and the rafters carried up to a centre post. It may be covered with flat iron, ruberoid, or 12 x 1 boards which have been ripped diagonally, so that all the points may be turned to the centre post. The need for a roof is



SILO ON BRICK FOUNDATION, OUTSIDE WALLS WEATHERBOARD.



SILO ON BRICK FOUNDATION, OUTSIDE WALLS PLAIN GALVANIZED IRON.

much less in dry districts, and it will be found that the rain which drifts down the inside of the half-empty silo does most of the damage. Still, when the silo has been built full height, it is advisable to complete the roof.

The cost of these silos may be calculated from the subjoined table of materials. In addition, a 100-ton silo requires 20 lbs. clout nails and 56 lbs. bolts and nuts. The contract price for the whole of the materials for the silo (15 x 21), as per specification, including roof, was £20 16s. (December, 1905). This included redgum foundation posts bolted together and tarred; studs bored for hoops, and tarred for 3 feet up, and the battens for the three lowest hoops were also tarred; all materials loaded on truck at North Carlton railway station. A silo 30 feet in diameter and 30 feet high (no roof) was erected at Adelaide Vale for £70. Another at Serpentine, 22 feet in diameter and 35 feet high (no roof) for £52. When more than 18 feet in diameter, it is handy to have a line of ports on opposite sides. More expensive silos, lined on the outside of the studs in the American style (but which the writer considers to be unnecessary in our climate), are shown on the preceding page. The first is at Ryburne, Outtrim, 22 feet in diameter and 23 feet high. The superstructure is set on 5 feet of brick work, cemented on the inside. The studs are 4 x 2, covered on the outside with white pine weatherboards rebated. Inside lining, one thickness ½-inch spruce, one layer P. and B. paper, and finally plain galvanized iron. Arrangements are made for the drainage of the concrete floor. The cost was £50.

Overground Silos.

DETAILS OF DIMENSIONS, CAPACITY, AND MATERIALS REQUIRED.

Length of Trammel.	Inside Diameter.	Height.	Capacity.	Studs.	Battens.	Iron.	Approx. Weight.	
							6 x 3 x 24g. Black.	6 x 3 x 24g. Galvd.
	Ft. In.	Ft.	Tons.			Sheets.	T. C. Lbs.	T. C. Qrs.
6 9	12 10	21	45	...	60 17 ft. 6 x ½	49	0 7 0	0 8 3
		24	56	29	66 ,, ,,	56	0 8 0	0 10 0
		30	80	...	78 ,, ,,	70	0 10 0	0 12 2
7 8	14 8	21	60	...	60 18 ft. 6 x ½	56	0 8 0	0 10 0
		24	73	33	68 ,, ,,	64	0 9 16	0 11 2
		30	100	...	78 ,, ,,	80	0 11 44	0 12 1
8 7	16 6	21	76	...	80 17 ft. 6 x ½	63	0 9 0	0 11 1
		24	94	37	88 ,, ,,	72	0 10 32	0 12 3
		30	130	...	104 ,, ,,	90	0 13 0	0 16 1
9 5½	18 3	21	95		80 18 ft. 6 x ¾	70	0 10 0	0 12 2
		24	118	41	88 ,, ,,	80	0 11 48	0 13 1
		30	160	...	104 ,, ,,	100	0 14 32	0 17 3
11 4	22 0	21	135	...	100 18 ft. 6 x ¾	84	0 12 0	0 15 0
		24	165	48	110 ,, ,,	96	0 13 64	0 16 3
		30	230	...	130 ,, ,,	120	0 17 16	1 1 1
13 2½	25 9	21	190	...	90 20 ft. 6 x ⅞	98	0 14 0	0 17 2
		24	230	57	100 ,, ,,	112	0 16 0	1 0 0
		30	310	...	120 ,, ,,	140	1 0 0	1 5 0
15 0	29 5	21	270	...	108 20 ft. 6 x 1	112	0 16 0	1 0 0
		24	320	65	120 ,, ,,	128	0 18 32	1 2 3
		30	450	...	144 ,, ,,	160	1 3 0	1 8 3

The second was built in 1902 by Mr. G. F. Syme, Dalry, Healesville. It is covered with galvanized iron on the outside, in place of weatherboards. Mr. Syme supplies the following particulars, which are of interest, as this silo was the first one in Australia built on the modern American plan:—"The pit has been in every way a success, and the ensilage has turned out in perfect condition, with the minimum amount of waste. The lower portion is of bricks laid in cement beneath the ground level, with a lining of cement; the portion above ground being built of timber studs of hardwood 4 inches by 2 inches, and 14 feet long, lined inside with 6 x ½ lining, then a lining of ruberoid 2-ply paper, and finally galvanized-iron sheets, with a coat of ruberoid paint applied. The total depth of the silo from the eaves to the floor is 24 feet, 14 feet above ground, and 10 feet of brick work below ground. The roof is sixteen-sided, with a ventilator on top. The internal diameter of the silo is 25 feet in the clear. It holds over 200 tons.

A cheap home-made silo, built of saplings and black iron (cost of materials, £11), is shown on page 179.

NOTES ON BUILDING THE SILO.

The foregoing directions should be followed out to the letter, as every point has been emphasized by the experience obtained in erecting nearly a hundred silos of this type. The foundation posts may be made long enough to stand more than 3 feet out of the ground with advantage if the silo is intended to be more than 25 feet high. Round or split timber will do for the posts, but if these are used it is necessary to adze the inside face exactly perpendicular, so that the triple hoops may be quite true. The upper edge of the third hoop from the ground must be exactly 2 feet 11 inches. This then allows an inch of the first row of sheet iron to show above this hoop, and thus riveting may be done with ease. The first port-hole may be made level with the lowest hoop if it is intended to excavate below the surface of the ground at any time, as shown in the accompanying illustration; but, if not, it is handiest to make the first port 3 feet from the ground. The distance of 3 feet from one point to the next is not a disadvantage in practice, as when the silo is being emptied, as soon as the top of a port becomes visible, the silage is excavated from behind the door until it can be opened, and the silage then raked down the slope towards this port, instead of being worked quite level as is recommended for the next 3 feet. Should it be desired to fill the silo while it is being erected, there is no difficulty in doing so. The lining is commenced from the bottom, and kept two rows of sheets ahead of the filling. The sheets should be painted before they are nailed up, and whitewashed as soon as the riveting is complete. This extra treading on the silage is an advantage, and there is also no difficulty about the scaffolding. In the ordinary way, a couple of 9 x 1 planks are used as a scaffold, resting on the hoops in succession as the silo is built, and the iron is nailed on, beginning from the top. Remember that each row of iron loses 1 inch from the lap, so that the top edge for a 21 feet silo is 20 feet 6 inches from the ground. It makes a neat finish to the top if an extra 6 x ½ board is nailed on the *inside* of the studs, so as to project 4 inches above the edge of the iron. If thought advisable, the whole of the materials may be tarred or painted before erection, and the iron should always be treated in this way, at least on the inside, to protect it against any acids that may be formed. As an additional safeguard, two or three wire ropes (the same as those used for stays) may be placed round the studs, say, at 5 and 8 feet from the ground, and twitched up tight. This is advisable if the silo is 30 feet high, or in any height when the timber is not of first quality. In fixing the purlins for the roof, the edge of the studs hardly needs notching at all, the bolt being quite strong enough to hold them together. In very tall silos, where the foundation posts stand, say, 6 feet out of the ground, another triple hoop may be built as part of the foundation at this height, and in all cases when any of the lower hoops show weak parts (knots or gum veins), they should be strengthened by making them of a double thickness of 6 x ½ timber. The foundation hoops of silos above 25 feet diameter are made of two thicknesses of 6 x 1 instead of three of 6 x ½.

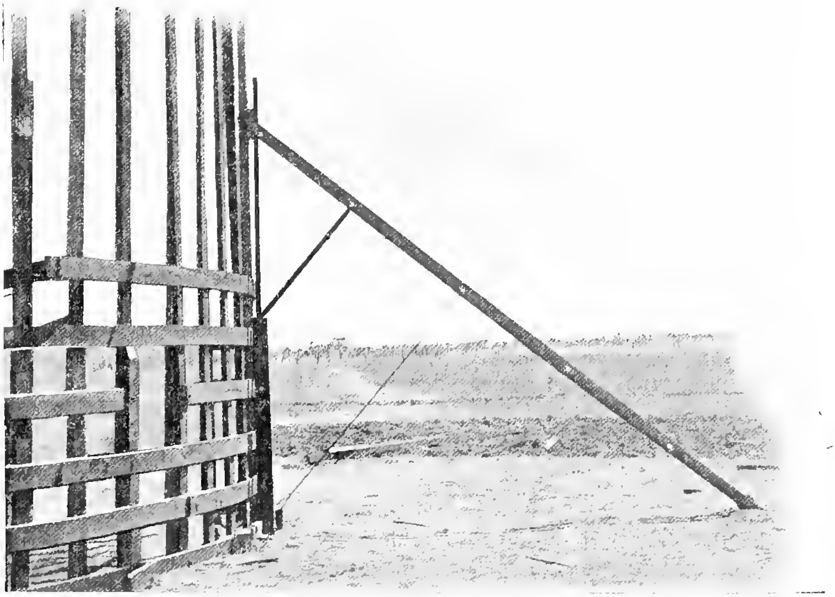


FIG 5.—DETAILS OF STAY. METHOD OF JOINTING HOOPS.

Staying the Frame.

A tall silo exposes considerable surface to the wind, and although the circular shape is the best to meet wind pressure, it is necessary to take precautions to keep it upright when empty. For this purpose stays are placed at regular intervals round the sides. Three of these are sufficient for a small silo, four for one 18 feet in diameter, and six for the larger sizes. They may be made of a good sapling, or built of 4 x 2, as shown in the accompanying illustration; or, what is perhaps the best method, is to secure the frame by wire ropes (or six strands of fencing wire twisted together) to a good post twenty or thirty yards away. This allows the teams to draw in to the chaff-cutter without inconvenience.

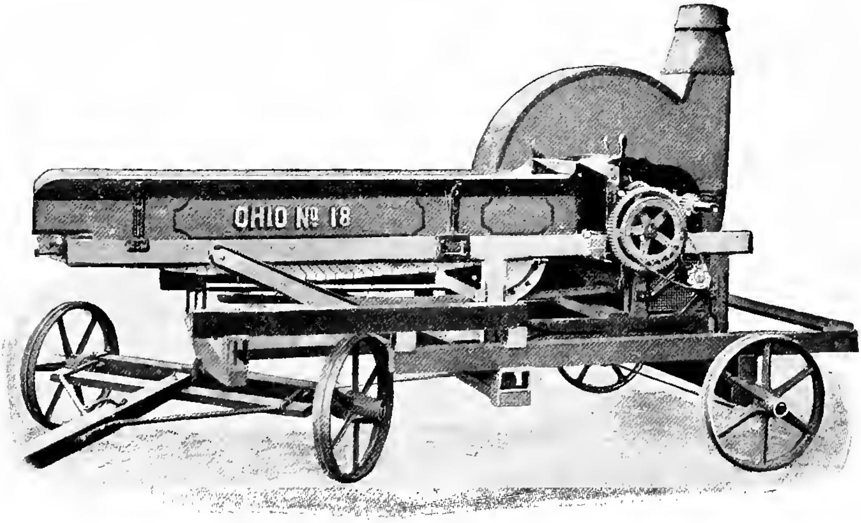
ENLARGING A SILO.

The silo built in this way is designed specially to allow of being increased in depth. The easiest way is to excavate the interior in a circle, as large as the inner face of the posts, to a depth of 6 or 10 feet or more. This gives 4½ clear all round, and allows of a brick lining. If the walls are good clay or slate reef, they may be made smooth enough without bricking, and in that case the diameter of the excavation is precisely the same as that of the finished silo, so that the inside face is perpendicular whatever the depth may be. Any irregularities may be plastered up with clay. If lined with brick, the inside should be finished smooth with a good coat of cement. When short lengths have to be used for the studs, these may be jointed in the following way:—The upper piece of 4 x 2 is halved for 9 inches, so that a 6 inch bolt is passed through the top of the lower 4 x 2, and then through the 2 x 2 tongue. In this way the upper studs are shifted sideways out of line with the bottom ones 2 inches; but the inside face is kept true. The long and short studs should be used alternately to break joints, and an extra hoop may be used to strengthen the silo in this part. As an instance of enlarging the silo, Messrs. McDougall Brothers, Minyip, built one 18 feet high last year, and now they have excavated it 10 feet below the surface, and lengthened the studs by 7 feet, making the total depth 35 feet. In the rush of the first season's work, it is often impossible to build it more than 18 or 20 feet, but next year the depth should be increased to 30 or 40 feet. Remember, a narrow, deep silo is better than a broad, shallow one.

To Fill the Silo.

1. Before filling, whitewash the inside with a thick wash made of lime and skim milk. As this dries in a few minutes, it is sufficient to whitewash the iron each evening high enough to allow for next day's filling.
2. As the ports are placed in position, see that they fit closely all round. If necessary, use thin clay to lute the joint.
3. As the filling goes on, it is impossible to tramp it down too much, especially at the sides. Get the youngsters from the nearest school to spend a couple of hours in the silo each afternoon.
4. From 4 to 10 feet of filling a day is a satisfactory rate.
5. When full, wet the top layer of silage thoroughly. Then spread a layer of old cornsacks, and cover with at least 6 inches of sand or earth. This is specially required when the silage is made of one of the cereal crops, but is not so necessary if maize or amber is used, although even then it is an advantage. A cover made of bags sewn together, and tarred, will last several seasons.
6. The shorter the stuff is cut, the better—½ inch is better than 1 inch.

7. The elevator requires to be driven slowly for a chain-belt elevator, but quickly for a blower.
8. The ordinary chaffcutter, with horseworks, will fill a small silo, but an engine is better for the larger sizes.
9. Arrange the work of filling so that the sheaves are carted direct from the binder to the cutter.



PORTABLE SILAGE CUTTER AND BLOWER.

There is some danger of the carbonic acid gas collecting after the first day or two if the silage is more than 4 feet below the first open port-hole. This danger is greatest in the pit silo, and the workmen should not go into them to resume trampling until the machinery has been running for some minutes. As the silage drops into the pit it will stir the air, and cause the carbonic acid gas to escape. The gas accumulates most during calm nights. The loss in the upper part is greater than at the bottom, so that it is always an advantage to add the weight, if this can be easily done; but the layer of moulds which forms on the top excludes the air pretty effectively, and the owners of a good silo rarely think it worth the trouble of putting on the weights by means of stones or earth when maize or amber cane is used; but it is always advisable to do so when the hollow-stem cereals are used.

The box elevator is used with chain-belt, carrying slats at intervals of 3 feet, and running over a sprocket wheel top and bottom. The bearings are adjustable, so as to tighten up the belt. The box is made rectangular, the bottom of two flooring boards, and the sides of one board each. It is driven with a pulley on the *top* spindle, a 3-inch belt being used. It must not travel more than 180 feet per minute. Nearly all machine men drive them too fast. The iron-work for a 27 feet elevator, including the chain belt, with slats affixed, may be obtained in Melbourne for £3 13s. A number of silage cutters, with blower combined, are in use in Victoria. By these machines the chaff is blown by a powerful fan up a tube placed nearly vertical against the silo. It may be blown up to heights of 50 feet or more. These machines require steam power.

Feeding Silage to Live Stock.

The most economical way to feed silage is to begin to use it as soon as the silo is filled; but of course in most cases this is not convenient, except for maize, which comes in late in the autumn. By so doing there is no waste from mouldy silage on top. It is best to rake off 2 or 3 inches from the surface each day, keeping the surface level, unless it is when a small excavation is made to open a port. Begin feeding small quantities, and increase the allowance as the animals become accustomed to it. It is never desirable to allow cows to fall off in the milk yield before starting on silage—begin feeding, say, about the middle of December in most districts, or as soon as the grass begins to dry up.

The comparative analyses of silage of various kinds are to be found in the earlier part of this chapter. It will be seen that it is rich in sugar, but poor in the flesh-forming constituents, with the exception of that made from the leguminous plants. Hence it cannot be expected to keep cows in first-rate milking condition unless supplemented with drier food containing a higher percentage of protein. Oaten, lucerne, or clover hay is the readiest and most economical method for the farmer to supply this requirement, and silage mixes well with grain of all kinds, bran, oil-cake, and other concentrated foods. It must also be remembered that in the cold weather the cow requires something more than bulky, succulent food. Just as in the summer, the dry requires to be supplemented with juicy food, so in the winter the silage should be fed along with hay or similar material. The art of the farmer consists not only in supplying the proper amount of food, but in furnishing the animals with the food best adapted to their requirements.

From 30 to 40 lbs. a day is about as much as the average cow can utilize to advantage. This amount furnishes about one-seventh of the protein, and from one-third to one-half of the carbo-hydrates that the cows require when in full milk. Sixty tons of silage will supply 30 cows for four months, provided it is supplemented as described above. For sheep it is found that 1 lb. a day will keep them if supplemented by a little dry food, while 2 lbs. is a fair allowance for ewes before or after lambing. Calculate at 1 ton a day for 1,000 ewes. Horses, 5 or 6 lbs. a day.

Crops for the Silo.

The best silage is made from plants with a solid stem, as maize, sorghum, and amber cane, while with these crops there is further great advantage that the whole of the stem, if the material is chaffed, becomes so soft and succulent that none is wasted by the animals. Considering, also, the total yield per acre, there is no question that where a crop is specially grown for the silo, one of these should be chosen. In the North, the abundant trefoil, barley grass, and self-sown cereals should be made into silage, because in most cases this is the best way to secure succulent food in the long, dry summer. Californian reports state that the trailing salt-bush, when chaffed, makes excellent silage. A mixture of peas, tares, beans, or clover, with maize, or the cereals, greatly increases the food value of the silage, and the mixture of barley or rye with tares and peas recommended in Chapter III. is excellent. This mixture has the additional advantage of being ready to cut by the end of October, so that, if necessary, a crop of maize may be taken off the same area of land.

POINTS IN FAVOUR OF THE SILO.

Silage may be made at all periods of the year, the crop being wet is no objection. In fact, if the crop is a little on the ripe side it is as well to take advantage of the dew, or even to sprinkle it with water, as the silage is being packed in the silo. Unlike hay, there is no danger from mice or other vermin, nor from fire. Silage will keep for years, and the moist warmth to which it is subjected effectively destroys the germinating power of seeds of every kind. The adoption of silage methods, therefore, conduces to clean farming. Once the elevator and machinery have been provided, the silo is the most important part of the farm equipment. All kinds of weeds and rubbish may be chaffed, and once in the silo they are sure to give full value as food. All kinds of materials seem to get the same flavour, so that animals readily eat the most unlikely substances. Hard thorns are softened till they do not hurt the mouth; and hard seeds are softened so that they may be readily chewed. Good cereal silage has the appearance and smell of brewer's grains, and no farmer should be satisfied till he has obtained his silage in this condition when ready for use.

PERIOD OF MATURITY.

Silage should contain 70 to 80 per cent. of water; that is, most crops should be siloed when the flowers are all out and the grain well formed. An exception occurs in clover, trefoil, and lucerne, which should be cut when in full bloom, and allowed to wilt one day before filling into the silo. Generally speaking, the crop is ready for the silo a little earlier than it is for hay. Maturity is very important in the case of maize and similar crops, which mature rapidly after the cobs are well formed. Immature maize contains little nutriment, as will be seen from the following table[1]:—

COMPOSITION OF ONE ACRE OF MAIZE AT DIFFERENT PERIODS.

New York (Geneva) Station.

		Water. lbs.	Dry Matter. lbs.
July 30 ...	Tassels, out ...	16,426 ...	1,619
August 21 ...	Kernels, milky ...	27,957 ...	4,643
September 7 ...	,, glazed ...	25,093 ...	7,202
September 23 ...	Crop ripe ...	20,542 ...	7,918

There is more danger of having the silage spoilt by being too dry than too moist, and where the crop is a little too mature the silage may be freely moistened with water, or, what is better, is to mix the green and dry parts of the crop. The large variegated thistles are excellent for this purpose. There is no difficulty about feeding them into the cutter, provided strong leather gloves are used to protect the hands.

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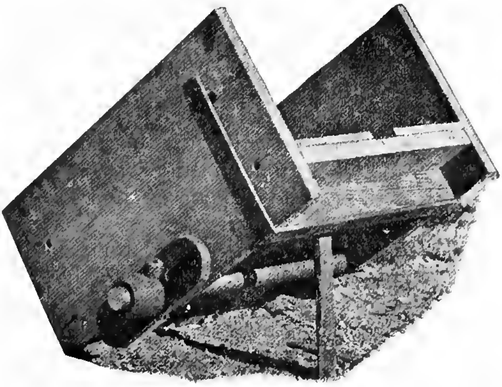
[1] From Henry, *Feeds and Feeding*, p. 167.

Other uses of the silo are—(1) to store grain or bran in bulk, and (2) to fill with ordinary chaff instead of building a haystack. If the hay sheaves are chaffed at once, not only is the expense of building obviated, but there is absolutely no damage possible from mice. These facts will pay for the silo in a single season.

Finally, the silo may be looked upon as the true method of insurance against dry years. Farmers should remember that the larger the quantity made the better will be the quality, and the less the cost per ton. There are at least 100 silos in use in Victoria, so that they have passed beyond the experimental stage, and any one following out the directions given above may look forward with confidence to the result.

Stack Silage.

In conclusion, a word may be said about stack ensilage. It will be seen from the foregoing that I do not recommend it for general adoption, on account of the amount of waste due to the imperfect exclusion of the air. This is shown by the fact that stack silage has always lost the peculiar aroma of chaffed silage, indicating the extent to which fermentation has progressed. In a year when there is abundance of fodder to hand, it is very much better to make a stack of some kind rather than be without succulent food in the dry weather. The main points about the stack are that it should be circular, and as high as possible. Settlement will reduce the height by about one-half. The stack requires to be weighted, and this is best done by placing a thickness of two or three feet of earth on top of it. A convenient plan is to build it inside a circle of saplings, which are surrounded by strands of fencing-wire to keep the walls upright, and to locate it under a tree with a suitable branch 25 feet from the ground. A pulley can be attached to this, and used to hoist up the last of the fodder, and the earth to be placed on top of it. If the binder has been used to cut the crop, the bands should be cut, and the sheaves spread out as the stack is being built.



SECTION OF ELEVATOR SHOWING ARRANGEMENTS FOR TIGHTENING BELT.

CHAPTER XIV.

THE HORSE.

TYPES OF THE SHIRE HORSE.

HEALTH FACTORS IN HORSE MANAGEMENT.

Although, by constant association with them, most horsemen acquire an instinctive comprehension of the normal and healthy features of their charges, it may be well to set down in definite terms what are the signs and habits of health in horses before dealing with the conditions which may induce an abnormal change, or with the methods and practices in management which make for the prevention of such a change.

Signs and Habits of Health in Horses.

Attitude.—*Stands* with feet flat on ground, limbs placed evenly side by side, with equal bearing and weight on each. The horse occasionally "stands at ease" by resting the hind limbs alternately—the joints are partly flexed, the fetlock is knuckled, the heel raised, and the toe rests lightly on the ground. The fore limbs are never so rested in health.

Rests at night and during the day, when undisturbed, by lying down with the knees and hocks flexed, and the body inclining slightly to one side.

Rises by raising the forequarters first, then gathers the hind limbs under the body, and springs to the upright position.

Gait.—Even and rhythmical movement of limbs, and even distribution of weight.

Appetite. *When Stabled.*—Eager desire for food—as distinguished from greediness or laconic picking—at regular feeding times. Desire for variant foods such as carrots, green stuff, grass, and the like. Refusal of mouldy or coarse food, also bones, lime, sand, earth, and rubbish. Slow rhythmic grinding of the bolus of food.

In Paddock.—Almost continuously grazing and moving, except when attention arrested, or when engaged in play, or seeking shade from sun, or shelter from wind or rain. Healthy working horses usually roll when just turned out; whinnying at familiar sounds, or when alarmed, is indulged in at intervals.

COAT.—Sleek, flat, glossy, and even (no harness marks) when groomed; greasy to the touch when not.

SKIN.—Supple and loose to handle; clean and free from scurf when groomed; scurfy when ungroomed. Pigmented (black) in most horses. Equable warmth and sensibility to touch all over.

EARS.—Mobile, alert, and evenly pricked.

EYES.—*Eyeball* bright and glistening, without excess of moisture or tears; sensitive to touch or approach of finger.

Pupil transparent, in shape oval or oblong, with rounded ends; sensitive to light contracting in a bright light and dilating in darkness.

White of Eye (sclerotic coat) clear, even white; not bloodshot or tinged with yellow or other colour.

Haw of the Eye and conjunctiva (lining of eyelids), carnation red, and moist.

Eyelids mobile and sensitive.

LIPS.—Mobile, dry, smooth, velvety, and sensitive to the touch.

NOSTRILS.—Dry, except for an occasional drop of moisture below the tear duct.

MOUTH.—*Lining* dull pink colour, moist, and free from clamminess. *Teeth.*—Incisors free from chipping or signs of wear, except on nipping surface; molars, even grinding surfaces, free from jaggedness at edges and from decay. *Gums.*—Upper bars level with teeth, soft and springy, but not tense, painful, or swollen, except during teething. *Tongue.*—Mobile, moist, and free from furriness.

VISIBLE MUCUS MEMBRANES (linings of nostrils, eyelids, and vulva).—Carnation red in colour, and moist.

HOOFS.—*Shape* approaching the circular on the ground surface; the hind hoofs are somewhat more oval. The natural angle at which the front of the hoof meets the ground at the toe is about 50 deg. in the fore feet, and 55 deg. in the hind feet, the latter being more upright and having usually higher heels. *Wall.*—The surface of the wall should be even, smooth, and polished, free from cracks, rings, or unevenness of growth. *Heels* broad and open. *Bars* strong and thick, to afford bearing surface for heel of shoe. *Frog* broad, full, and springy, free from moisture and fœtid smell; should show signs of wear by contact with ground. *Sole* dry and flakey; free from moisture; absence of softness and powdering texture. The hoof horn should be tough and yielding, not rigid, brittle or "shelly." The off and near hoofs should be uniform in size and shape.

ANUS.—Full and prominent in young horses; clean and free from scurf and scales.

DEFÆCATION.—Moderate frequency of bowel movements—the average being 10 or 12 times in 24 hours—unaccompanied by fœtid flatus and without unpleasant smell.

FÆCES (dung). *Quantity.*—From 25 to 35 lbs. during the 24 hours, a greater bulk being passed during the night than the day time. *Appearance.*—Moderately dry and balled, with moderately firm coherence of particles, but without gluey consistence or coating; free from whole grain or only partially disintegrated food particles; colour corresponding with character of feed. (Balled fæces of normal cohesion float in water.)

URINATION.—Desire to "stale" on returning to the stable or on being bedded down.

URINE.—*Quantity* varies according to diet and activities, being less in horses at work; average about nine pints per day, passed at three or four stalings. *Appearance*.—Yellowish-red or straw colour, and turbid, without excess of sediment, blood tinge, sliminess, or fœtid odour. The urine of mares in season has an oily consistency.

TEMPERATURE.—*Internal*, 100 deg. F. to 101 deg. F. *External*, moderate and even warmth of body surface; warmth of ears, extremities (pasterns and cannons), and hoofs uniform.

PULSE.—From 35 to 45 beats per minute.

BREATHING.—From 12 to 15 respirations per minute. Even rhythmical rise and fall of ribs and flank; absence of tifting cough or other noise, and of double flank heave on sharp exercise.

Causation of Disease.

There are a variety of matters which have a more or less important bearing on successful horse management; matters which, taken singly, may perhaps be considered of little moment, but which, taken together, make all the difference between success and failure. The care, experience, time, and money spent in breeding and rearing horses are practically wasted if the stock is not maintained sound and healthy. If unsound or diseased, horses are unprofitable financially and useless economically.

Methods and practices which have for their object the maintenance of health and soundness hinge so largely on a knowledge of the causation of disease that it will be well to touch lightly on that aspect of the question first, for the old medical axiom, "Remove the cause and the effect shall cease," is as true of disease prevention as it is of disease treatment. It is not intended to deal with the actual causes of disease, such as germs, poisons, injuries, accidents, and the like, but rather with those conditions which may be said to constitute predisposing causes of disease, *i.e.*, those factors which render animals exposed to them more susceptible to the attack of actual disease causes, or which have a tendency to undermine the natural vigour and disease-resisting robustness of the constitution. Leaving aside, as being beyond the control of the horse-breeder, such predisposing causes of disease as climate and locality, the subject of overstocking may be first dealt with.

OVER-STOCKING.

Apart from the ill effects of continuous grazing in the way of soil exhaustion, and apart also from the actual fouling of the herbage by excess of animal discharges, and the worms and parasites which they contain, over-stocking has the further disadvantage that the good grasses are continuously eaten off as they shoot into growth, and are thus prevented from seeding. In this way the extirpation of much wholesome and nutritious herbage is hastened. At the same time, useless, and perhaps actually harmful and noxious plants which are not eaten by stock until the pastures are bare of the more valuable grasses, are permitted to flourish and seed, until eventually the unnutritious plants predominate owing to the good grasses having been eaten out. A familiar illustration of this is the gradual usurpation of a pasture by Yorkshire fog grass. Wherever this grass is sown with sweeter grasses, the latter are eaten down continually, while the fog is neglected by stock owing to its harshness, and, being a strong grower, it soon takes possession of the pasture. Even in times of plenty the folly of overstocking is not less acute, for then the less valuable and noxious plants are left still more severely alone by stock, and they then propagate and spread their baneful presence over the whole pasture, occupying ground that would otherwise accommodate herbage of a more nutritious character.

FOOD AND WATER.

The food and water supplies are important factors in the maintaining of the health of stock. On the one hand, excess of food, either in quantity or quality, may predispose an animal to indigestion, colic, congestion of the liver and like derangements of the digestive functions, and on the other hand, lack of food or starvation, by inducing debility, will lay the system open to the successful attack of germs and other direct causes of disease. Unsuitability of food is equally likely to pave the way for disease. Feeding on musty hay, for example, for a lengthened period, will, if it does not actually cause the disease, at all events precipitate an attack of asthma or broken wind. New hay and partially fermented chopped foods are notorious as auxiliary causes of colic and other bowel disturbances.

While it may be admitted that horses do not require that their food should be varied to the extent requisite in man or other omnivorous animals, all experience points to the advisability of an occasional change of food. A diet which is suitable in the depth of winter is not calculated to be health-maintaining during the excessive heat of summer, yet the wheaten or oaten hay or chaff ration is seldom altered; and, if supplemented, it is by the addition of oats or bran, by which the monotony is not varied. The want of variety is rarely relieved by the giving of carrots or other alterative food, and it is very exceptional for barley, maize, beans, peas, or linseed foods to be used. At certain seasons green stuff may be given, but, consisting as it usually does of young oats, it is no change, such as an occasional feed of green vetches, peas, beans, or prairie grass would be.

What has been said regarding food in excess or deficiency may apply also to water, although animals will rarely take an excess of water if they are allowed continual access to it. On many extensive grazing areas throughout Australia, and particularly during drought periods, the only available supply of water is that contained in natural water-holes or artificial tanks. Such stagnant water is always highly charged with vegetable growth, and often with the urine and excrement of animals which have unrestricted access to it. In hot weather it is likely to become putrid and filthy, and it forms an ideal developing medium for legions of worms and other parasites. Contaminated water, by virtue of the organic matters and microbes it contains, is often an exciting cause of disease. Indeed, there are grounds for believing that the influence of contaminated water in the propagation of various epizootic diseases, has not been given sufficient weight.

ENVIRONMENT.

The environment of animals has also an important bearing on their freedom from disease. Unwholesome surroundings may, according to their character and intensity, either excite disease or predispose the animal to an attack. Vitiated atmosphere as a result of deficient ventilation and air flushing is often a contributory cause of pneumonia, influenza, and other debilitating diseases in stabled horses. So noticeable is the effect of insanitary surroundings on the occurrence and spread of certain dseases that it has become customary to group them together under the term "filth diseases." By this is meant not so much that filth in itself will cause these diseases, as that their causative germs will find in the unclean surroundings—deposits of dung, manure, and rubbish, stagnant drainage, and the like—ideal conditions for maintaining germ life. As instances of such filth diseases in horses, lockjaw and influenza may be mentioned. Want of cleanly surroundings, especially of working horses, encourages skin diseases such as mange, eczema, mallenders, cracked heels, mud fever, and grease. Want of shelter from cold and rain, or want of clothing, by preventing the conservation of bodily heat, and want of shade from excessive sun heat by retarding radiation of bodily heat, all influence the natural vigour of the animal prejudicially, and so predispose to disease.

HEREDITY.

The influence of heredity is well known to be potent for good or bad, according as the parents are sound and healthy, or unsound and diseased. With the majority of diseases that are classed as hereditary, such as roaring, broken wind, spavin, curb, navicular disease, ringbone, cataract, &c., it is the tendency to develop the particular disease which is inherited, and not the disease itself.

In-breeding, which is closely allied to heredity, tends to accentuate characteristics, and may occasionally be practised with advantage, but intimate knowledge with its laws is necessary to prevent deterioration of constitution. Nearness of blood relationship (called consanguinity) emphasizes the tendency to development of hereditary defects, so that where disease exists in a family, close breeding should be rigidly avoided. The bringing together of strains which each possess, unsuitable characteristics or a tendency to contract the same disease is very unwise for the same reason, viz., the likelihood of such characteristics or tendencies being accentuated in the progeny.

Cross-breeding will at first favour increase of vigour, but much harm may ensue through want of knowledge of the effects of prepotency in sire or dam or through injudicious mating.

Prevention of Disease.

Just as the conditions that have up to the present been referred to tend to the acquirement of disease, so there are certain factors which make for healthfulness and soundness, and which, if taken advantage of systematically, will largely contribute to success in live stock husbandry. Of these the questions of breeding, feeding, watering, management, and cleanliness are worth considering in detail, and will be dealt with in the order named.

BREEDING.

Care in the selection and mating of breeding stock is necessary for the prevention of those diseases which are generally regarded as hereditary. Horses affected with any of the following diseases or unsoundness should not be used for breeding purposes:—Nasal disease, rheumatism, rickets, roaring, whistling, broken wind, grease, navicular disease, ringbone, spavin, bogspavin, thoroughpin, curb, and cataract. It would be well, too, if breeding from stock possessing radical defects of conformation was avoided—such as, particularly, those with calf-knees, bent legs, round gummy joints, flat feet with weak "corny" heels, narrow contracted heels and muley feet, sickle hocks, knuckled fetlocks, and long weak pasterns, those "tied in" below the knee and hock, and those which "brush" or "speedy cut."

HEREDITARY UNSOUNDNESS.

The supineness of Australian horse-breeders generally, and particularly those who have the management of stock shows and stallion parades, in regard to the question of transmissible unsoundness in breeding stock is remarkable. It has been apparently begotten of that carelessness in the selection of sires and dams which was engendered in the days when horse flesh was a drug in the market. But in these present days, when ordinary sizeable three or four year old draught colts commonly fetch £40 to £50, and harness horses are proportionately valuable, it is surely little short of a scandal that prizes are commonly awarded at agricultural shows, which are supposed to exist for the improvement of agricultural stock, to sound and unsound breeding stock indiscriminately.

FEEDING.

The most essential attribute of food in so far as it may be a factor in the maintenance of health, is that it should be sound. Musty hay inducing broken wind in horses, is a familiar instance of the ill effects of unsound or decomposing food. Next to soundness of the food comes the necessity for regularity in feeding, and that the food should be in due proportion both as regards quantity and quality. By the observance of regular hours for feeding animals, and regular and not too prolonged intervals between feeding, a rhythmical action of the digestive organs is brought about, which induces more perfect digestion and makes for disease-resisting strength.

As a general rule for all herbivorous animals, the advice to feed little and often is good, in that it is in accord with the method of feeding in a state of nature. When such a practice is adopted with stabled animals, there is less likelihood of any food being left over, and consequently the tendency to stomach and bowel troubles resulting from the ingestion at next feeding time of soured or fermented food is minimised. Soiled food should always be removed after feeding, and should never be mixed with fresh feed. Complete mastication of the food is necessary to perfect digestion, and in the case of animals with the habit of "bolting" their food it is advantageous to let it be coarser than usual, so that chewing and grinding may be assured.

WATERING.

Very diverse views are held as to the proper time at which horses should be allowed to drink—whether before or after feeding. The most natural plan is to always have water accessible to the animal. If this is done, as much water will be taken as is required, and no more, and it will be taken when required and at no other time. The opinion that water should be given only in limited quantities—limited, too, according to the judgment of man—is an error. Horses in health seldom or never take more than they require. It is conceivable that after long enforced abstinence, as after profuse perspiration, they require—and take—more than is good for them to take at one drinking; a quantity indeed which will, by its volume of coldness, produce stomach or intestinal spasm (colic). In such circumstances it is advisable to interrupt the drinking for a time, or to take the "chill" off the water by warming it slightly, or by adding a little warm water to it.

It is well that water should be withheld for some time prior to the imposing of violent exercise or work. Racehorses, for example, should not be allowed water in a considerable quantity during the three or four hours preceding a race. Perhaps the only other time when it is inadvisable to allow a long drink, if it is desired by the animal, is immediately after feeding, when the fluid, in passing rapidly through the stomach towards its natural receptacle (the cæcum or blind gut or water gut) is likely to carry with it into the small intestines some of the stomach contents which are still crude and harsh, and not in a sufficiently digested state to pass on, and which, therefore, may irritate the mucus lining of the bowels to an extent sufficient to set up colic, or even inflammation of the bowels (enteritis). For similar reasons, if water is not kept continuously within reach, in which case, as previously stated, as much as will do harm will never be taken, the watering should always be done before feeding.

The necessity that drinking water for animals should be pure and wholesome is obvious. On farms where the water supply consists only of water-holes, which become foul and fœtid from pollution by animal discharges, water-troughs supplied by windmill should be provided. The objection is sometimes raised that where water-holes and swampy patches are numerous, it is of no use providing drinking-troughs as horses will not make use of them; but it will be found on trial that horses will always go naturally to clean water. In point of fact they may be frequently observed to refuse or drink but sparingly of contaminated water. They may be seen to go to a foul and slimy water-hole, stir the water by wading, then smell it, and drink a little or wade out without drinking at all. That their thirst is not assuaged is evidenced by the fact that they may be seen to return and repeat the performance time and again.

MANAGEMENT.

So far as the prevention of disease is concerned, good management includes the continuous provision for housed animals of comfortable quarters and bedding, an adequate supply and interchange of fresh wholesome air without the occurrence of draughts, suitable clothing, efficient grooming and cleansing, and regular exercise, or work in moderation. For animals in the paddock, in addition to an adequate supply of food and water, shelter or protection by rugs from wind, rain and insects, and shade from the sun, are of the highest advantage. It will be found by careful observations over a longer or shorter period of time, that the measure of health or freedom from disease of any stud of animals is in ratio due to the amount of care exercised in regard to these items of management.

There are certain times at which extra care in the management of stock is necessary and profitable. Foals should be kept growing during their first winter. It is the worst possible policy to let them get low in condition either from shortness of food or lack of protection from the weather. An ideal winter paddock for young stock should contain a straw-stack, whereby both shelter and a picking of dry food is afforded. A check received during the first year is seldom made up for, and it will go hard with under-conditioned youngsters if anything in the nature of contagious disease gets amongst them. Weaning time is also a critical period. Foals should be gradually accustomed to take a little good hard feed for some time before they are removed from their dams, otherwise the sudden loss of milk will be severely felt.

CLEANLINESS.

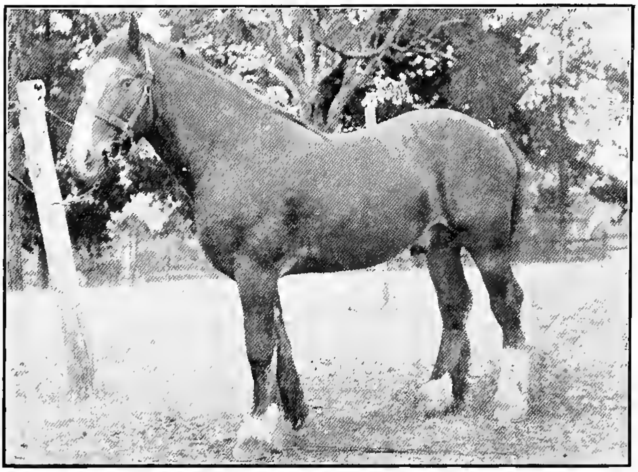
Although perhaps, strictly speaking, this should have been included along with management, cleanliness is so much a thing apart in importance from all other factors in the prevention of disease, that the strong emphasis of separate consideration is incumbent. Cleanliness means, simply and essentially, the absence of germs and the lack of means for their multiplication and development. Diseases caused by germs make little headway where cleanliness in all things prevails. Nothing more need be said on the subject of cleanliness if the fact is impressed that cleanliness in all things connected with horses—in their surroundings, their feeding and watering, their housing and paddocking, when working and when at rest—is above and beyond all things the most important factor in the preservation of health and the vigorous resistance of disease, and that it is the essential feature in the subjugation of the spread of infectious and contagious diseases and of the germs which cause them.

THE DRAUGHT HORSE.

The draught horse in Australia is largely a composite of the three types of draught horses as known in the United Kingdom, viz., Clydesdale, Shire, and Suffolk Punch. The cross between the two former is the most favoured in this State. For a long time the first named was the most in demand. This, I presume, is to be attributed to the fact that the major portion of the earliest importers and owners of high class draught stallions and mares were from Scotland. The acumen they displayed in the selection and mating of their favorites is amply proven by the many specimens existent to-day, the progeny and descendants of stock bred by those shrewd pioneers. Looking back some 30 or 40 years ago, the names of the men from Caledonia who were in the foremost rank of breeders of high-class draught horses were legion. They undertook a great work, and carried it out successfully; and though with the construction of the railways the local use of the draught horse is not so great as formerly, when supplies were carted over hundreds of miles by horse teams, it is satisfactory to note there is a keen demand in other States for the superior type of draught horse bred in Victoria.

The Clydesdale.

Notably the Clydesdale is active, and while it, as at present bred, lacks the weight of the Shire horse, in its movements it is faster, possessed of good bone, lengthy sloping pasterns, and well turned limbs, carrying not too much hair. For ordinary farm work it is a valuable animal, it being essential that strength and activity should combine in such an animal as is required for this particular class of work, as also for the more active and lighter type of lorry or stout delivery horse. Possessed of good crest, well-set muscular shoulders, round barrel, well ribbed, and closely coupled across the loins, this type is in comparison with the Shire horse as bred to-day, slacker in the hind quarters, both in depth and width, with a tendency to shrink off towards the tail, in very many cases being very narrow. Again, the gaskin is rather light, and although the hocks may be, and for the most part are, well shaped, the upper structure of the hind quarters is on the light side when taken in conjunction with its massive fore part. It may be this is a wise provision of Nature, that the hind quarters should be so formed in order to give the animal greater activity, or, in the parlance of the stable, better driving power. Before closing this notice of the Clydesdale, it is but fitting to remark that within the past decade the change which has been wrought in this type of animal is wonderful. Originally there were many points in common between the Shire and Clydesdale types, but within the period cited it would appear that it has been the aim of the fanciers of each to render the two classes distinct, and they have succeeded in their desire to the detriment of the Clydesdale.



CLYDESDALE TYPE—BEN NEVIS.

The Shire Horse.

The Shire type, or as he was at one time known as the " English Cart Horse," is to-day a much heavier class of animal than the Clydesdale, with the bones in the limbs rather more razor form than those of the latter type. At one time the Shire horse was notorious for its poorness of foot, having low shelly walls and narrow heels. During the past forty years breeders have succeeded in producing an animal with a sounder foot, having strong walls, and good wide heels. As the result of, or coupled with this action by the breeders, they have brought about a decided change in many other points tending to improve the quality of the animal. While standing no higher on his limbs than the Clydesdale, he is at the same time heavier boned, more massive in the barrel, heavier quartered and close coupled with well-knit ribs. They are really moving mountains of muscle on limbs of steel, with the weight in the case of stallions in some instances of 2,700 lbs. As might safely be judged by his massiveness, he is slower in his movements than the Clydesdale, and, consequently, more fitted for the slower and heavier classes of work where great strength is the first requisite. Viewing the high-class stallion of this type of these days, it seems hardly possible to believe that the progenitor of this class was at one time the old English war-horse; and one can readily believe that a troop of such animals when once set rapidly in motion would cause the ground over which they were being moved to fairly shake again with the concussion of such ponderous masses, to which greater weight was given by their mail-clad riders.

During the past year some fine specimens of this type of animal have been imported into this State, and buyers from different portions of the Commonwealth have, by the high prices paid to secure them, proved the judgment of the local men was not at fault.

The Suffolk Punch.

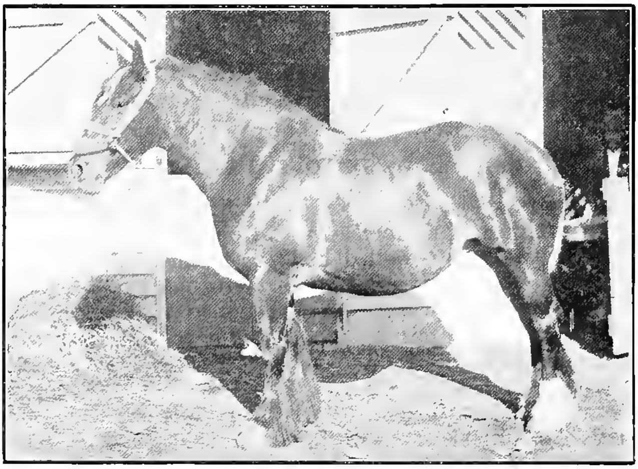
The third type of draught horse, the Suffolk Punch, is of a more nuggety form than either of the preceding breeds spoken of, with clean limbs, well-set crest, closely-knit well-ribbed top, rather inclined to be hollow backed, strongly quartered, and in pure breds chestnut in colour. At one time there were very many more of these horses bred in this State than at present; but as many of our draught mares have a strain of this blood in them, it has been thought well to give a passing notice of them. This breed of horses originally came from Flanders, and has been crossed with the Percheron to a great extent. Several of the Continental Governments, I learn, use them largely for crossing with light-boned mares to produce weighty artillery horses.

Origin of the Australian Draught Horse.

From the admixture of blood of two or more of these types of horse has come the Australian draught horse as we find him to-day, and from his contour and appearance we can with safety gauge the preponderance of Clydesdale, Shire, or Suffolk Punch, according to the characteristics manifested by the various animals. Careful selection guided our noted breeders in the past in producing animals to supply the current demand, whether for the heavy, medium, or lighter kinds. Hence it came about that with varieties such as these mentioned, with qualities so strongly marked in each particular class, it simply resolved itself into the question whether the owner of a dam of given quality would mate her with a Shire or a Clydesdale in the hope of obtaining an animal best suited to meet the requirement he had in view. He was assured that, unlike the case of thoroughbreds, where a weed might in all probability result as the progeny, he was sure of a good saleable animal, although one, perhaps, not up to his expectations.

If the demand is for the medium class of draughts, such as ordinary farm or active lorry horses, the Clydesdale sire should meet breeders' requirements; but if the weightier animal is required, then the Shire stallion should merit the breeders' favours.

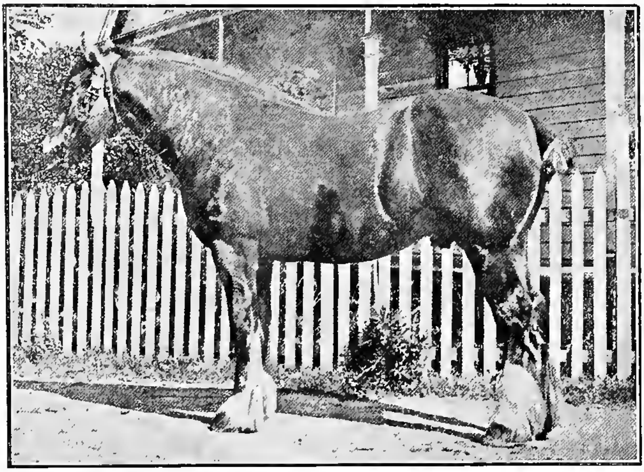
In the selection of the mare great care is necessary. In the first place, she should be of even temper, standing well up on her limbs; these should be free from all defects. She should, further, be well ribbed, with an abundance of room in the barrel, and have good lung space, and her feet should be encased in good strong hoofs. In order to produce an active foal, a further essential is that she should not be sluggish in her gait, as like too often produces like, and never mind what care is exercised in selecting the sire, it often happens that the foal throws to the mare, and is sluggish and ungainly in its action. Through the courtesy of her former owner, Mr. J. Crozier, who has kindly supplied me with a photograph of "Lady," and a few particulars relative to her, a reproduction is given of this magnificent animal which was bred by the Hon. E. H. Cameron at Kangaroo Ground. "Lady" has won over twenty first prizes, including the first and champion at the last exhibition of the Royal Agricultural Society of Victoria, securing at the same time the gold medal in her class. She stands 16·3 hands, is a rich bay in colour, with black points in front and hind feet white, with a girth measurement of 7 ft. 10½ in. As will be seen on reference to the illustration, she stands on strong short limbs, with an abundance of substance, and is at once the embodiment of docility, compactness, and strength. By "Latest Fashion," whose photograph is reproduced herewith, she is from "Gyp," and has since the show alluded to, been sold to Mr. Smith, Leongatha, for £250. Now, while it may not be possible for each to be the owner of such high-class animals as "Lady," it is certainly within the reach, and it should be the desire and aim of owners, to realize it is their duty to attempt the improvement of their stock, whether it be for a matter of pleasure or profit. A good animal is as easily kept as an inferior one, and much easier to sell. Hence it behoves breeders to use the greatest care in the selection of stallions to which they may send their mares. Too often it happens that a neighbour has a nondescript with no points to commend him as a stallion, the services of which, costing little, are obtained. As in the case of the dam, it is of the greatest importance that the sire should be possessed of abundance of constitutional vigor, docile in temperament, and stand on good legs and feet. These latter having to bear the weight of the animal's body, should be encased in good healthy hoofs, as it too unfrequently happens that many a beautifully topped, otherwise well limbed animal, is altogether disqualified through bad, shelly, and cracked hoofs, with shallow



CLYDESDALE MARE—LADY.

narrow-heeled feet, which are altogether incapable of supporting the animal's weight. Further, this type of foot is to be regarded with suspicion as evidence of constitutional defect, and as stud-masters uniformly consider it their duty to cram on all possible fat on their stallions the foot too often betrays and serves as an index to the state of the general health of the animal.

While horse-breeding may not, in so far as individual owners are concerned, be carried on so extensively as has been the case when land was less valuable, the breeding of the type under review will still be carried on by many who may be owners of possibly not more than one or two mares. With such as these and the holders of a limited acreage, it is essential the animals reared should be valuable, as of necessity they must be fed from an early age. Their mothers can be conveniently employed for the greater portion of the year at their ordinary work. In fact, it is much better they should be constantly kept at steady work during the time they are carrying a foal. This will prevent an undue formation of fat and tend to muscular development. Care must, however, be taken that between the tenth and twentieth weeks after the mare proves in foal, not to allow her (or in fact at any time) to be jerked about whilst at work, or abortion may ensue, often with disastrous consequences to the mare.

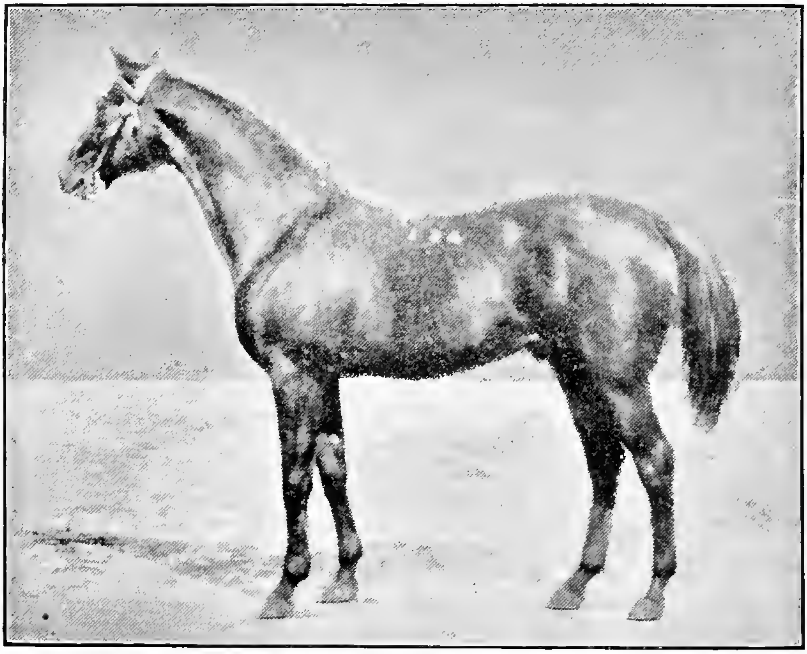


AUSTRALIAN-BRED CLYDESDALE—LATEST FASHION.

The same axiom applies after foaling, as the dam may safely be put to work shortly after giving birth to the foal, care being taken not to allow the foal to suck if the mother is over-heated or trouble will result in consequence. The young animal should receive a fair amount of good nutritious, bone-forming food as soon as it is able to partake of it, and while the mother is feeding from trough or manger, the foal will readily join her in her meal. It is mistaken economy to stint the mother or foal, and the pernicious habit of merely allowing them wheat husks, or as it is commonly called "cocky chaff," undamped or in any way made appetizing, as it should be by the addition of bran or crushed oats, is cruel if cheap. After such treatment owners complain of unknown and mysterious diseases occurring among their young stock, and the solution of the mystery rests in the fact the animals have been starved, and rickets has supervened.

LIGHT BREEDS.

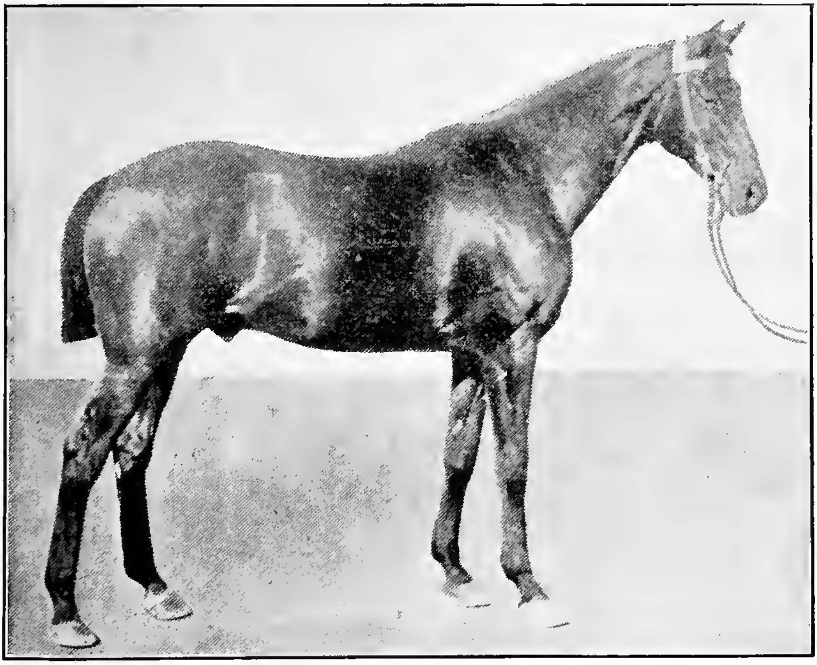
Glancing back over the names of some of the stallions whose blood is diffused in various degrees through the light horses of this State, one is struck with the fact that such speed makers must have left some strain of such in their stock. Nor was speed the only essential quality possessed by those old champions; in a greater or lesser degree, endurance, stamina, and staying power were also present, as proven by their contests on the turf. Take, for instance, a few only of the many whose names are linked inseparably with our light horses, and we find the blood of such sires as Stockwell, Touchstone, Fisherman, Whalebone, Ace of Clubs, Whisker, Cardinal Wiseman, Snowdon, Panic, King Alfred, Fryingpan, Padlock, Glorious, Lochiel, Musket, Pilgrim's Progress, Tradition, Hova, The Admiral, Chester, Malua, The Barb, Glencoe, Tim Whiffler, Swiveller, and many others of equal notoriety, and whose names are legion.



TYPE OF THOROUGHBRED AUSTRALIAN STALLION.

"Pickwick," by Swiveller"; dam, "The Gem." Brown Australian Horse. 9 years. Height, 15.2¾. Girth, 69 in. Shank, 8 in.

As a matter of fact, all mares cannot be stinted by such animals for many reasons, among others that of cost, but the descendants of such animals from good dams scattered throughout the State must tend to improve the quality of our light horses, by imparting action, form, endurance, or other marked conditions of quality to their stock. The several blendings by this diffusion of blood, exhibited sooner or later, according to the quality of the mares from which they spring, the characteristic of the stallion. In the case of some sires this became very pronounced, notably so, those strains with Panic and Snowdon blood, well to the front. But with breeding light horses, owners have too often sought to produce racehorses only. Every nondescript mare that was sent to a good horse was expected to throw such an animal. Too often the progeny thus derived proved a failure, and when a colt, instead of being castrated, it was put to the stud. To such a failure, because his services cost but little, its owner's neighbours in their turn sent their mares, and the progeny in many cases were subjected to the same test as the sire, viz., the turf first, and the stud afterwards, and their stock afterwards to similar conditions. The reason was, in the first case, the lineage from which he sprang on the sire's side, the dam being forgotten or unheeded. With such a condition of affairs it is not to be wondered that the quality of the stock suffered a decadence for some time, and this, coupled with the low prices prevailing, caused many owners to direct their attention to more profitable pursuits. Needless to say, many breeders of good serviceable light animals did not allow themselves to be led in adopting such tactics, but made it their aim to breed an animal which would be capable of doing good work and at the same time command a fair price, though only too often much below the actual value of the animal. The yearly drain on our light horses for the Indian market, as cavalry and remounts for artillery, and also for private use, augmented by the demand for light horses during the South African war, has tended to cause a dearth of mares from which to produce suitable stock when mated with thoroughbred stallions.



TYPE OF HORSE FOR CAVALRY.

No. 2981. Brown Australian Gelding. 8 years. Height, 15.2.

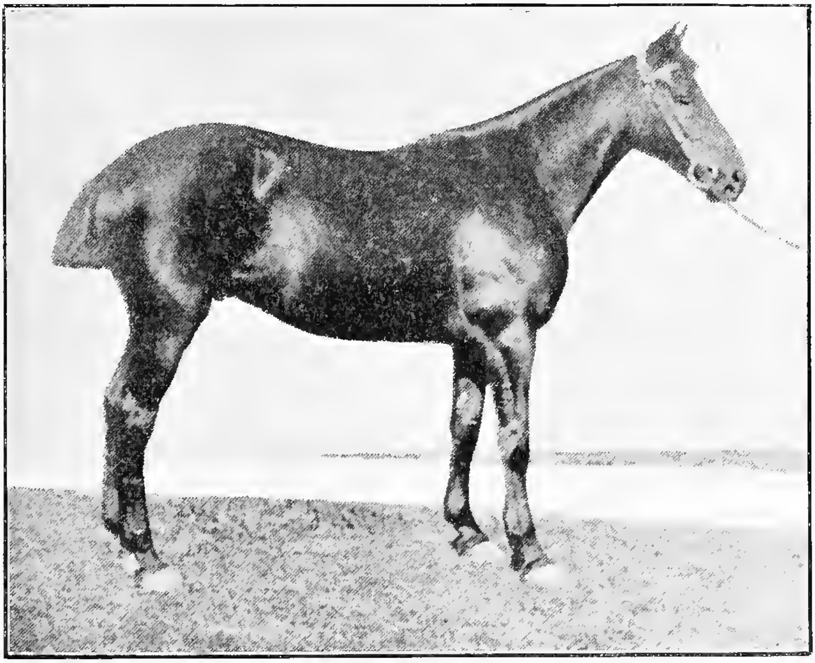
This is to be regretted, as a reference to the report of the "Horse and Mule Breeding Commission, India, 1900-01," shows its effects are likely to be far-reaching. On page 6 of this report it is stated the following communication was received by the Commission from the principal shippers of horses to India:—"We have the honour to place before you our views regarding the horse-breeding of Australia. In our opinion it is deteriorating, due to the use of inferior stallions, and exporting most of the best mares, breeders being tempted to sell on account of the high prices given for Indian remounts. We think it would be beneficial to the industry if you were to advise the Australian Governments to put a heavy tax on stallions, and limit the exportation of mares suitable for breeding." Again, to show the importance of the upkeep of suitable animals, not only in this State but throughout Australia, on page 8 of the above report, under the heading of "Reserve," it is stated:—"Australia is the country from which the horse supply must be supplemented."

The Hackney.

A great deal of controversy is always taking place regarding the present quality of our horses suitable for hacks. All buyers know the difficulty there is experienced in obtaining such animals, and this should not be in a country possessing, as Victoria does, so much land available for breeding the very best of horses. Many persons remark that the Indian buyers have cleared, and do clear, the place of all the sound animals, and no doubt they are responsible for this to a very great extent, but on the other hand Victoria ought to be able to keep up the supply, and with profit to the breeders. I have taken particular notice of this subject for several years, and am satisfied that the main cause of the quality of so many of our horses being deficient is to be found in the fact that a great many breeders did not consider the necessity of providing their stallions with suitable mares. The stallions themselves are in very many cases all that could be desired, and with first-class pedigrees—strong, stout, well-built, good-boned thoroughbreds. But to breed a hack you must mate the sire with a picked mare. For instance, get sound, active, strong mares, say 15½ to 16 hands, good movers, nice clean heads decently placed, placed on good lengthy, strong necks, mares able to trot along with a spring cart, and themselves having some strain of blood in their veins—for choice, on the side of the sire. Then, with a little luck, hacks of a proper standard should be the result, albeit that the country upon which they are bred is good horse country, as half the breeding, and a good big half too, goes down the throat of the young stock during the early years of their lives. Several years ago, when the 'Bus Company was running at its full strength, many mares of the class alluded to were owned by them.

If a breeder possesses an active, sound plough mare, not too heavy (always, be it understood, that she is good about the head and neck), and cross her with a picked thoroughbred stallion, and in the event of the progeny being a filly, in due time put that filly to another picked thoroughbred Arab or Welsh pony stallion, the foal then produced should make a good class hackney. But putting the best of sires to mares without bone or substance will not produce a hack. You cannot reverse the order of things and breed from the blood mare by the draught stallion, as in that case not only are you liable to excessive mortality in foaling, but the progeny invariably carry the heavy head, shorter neck, and thick withers of the sire, all of which are dead against the points of a hack.

Again quoting from the report already alluded to, and to emphasize the necessity of pure bred sires, whether thoroughbred or Arab, on page 16, it is stated, alluding to so-called roadster and hackney stallions:—"Incalculable harm has been done by the introduction of hackney stallions (in the term hackney is included Norfolk trotter, under which designation some of the coarsest and worst stallions were sent to India). The type of horse of this class received from England has been inferior and coarse. It was claimed by the advocates of the hackney sires that they would give room and increase the bone of the country bred; though the cross may have resulted in room, the bone has deteriorated both in size and quality. Up to eighteen months the progeny grow shapely, but from that age to three years old they begin to throw out all the bad points of their sires in an intensified form—soft, enlarged joints, straight and heavy shoulders, great want of bone, and generally coarse appearance." It should therefore be the aim of breeders to avoid this type of sire; he is but a composite animal in so far as breeding is concerned, and however well he may look himself, his stock are uniformly failures. Therefore in the selection of the sire to mate and nick in with the type of mare from which most of our best artillery and remount horses must necessarily come—viz., the active draught type—it is essential that the services of the thoroughbred or Arab must be brought into requisition. The first cross from such an animal should produce a gun horse, and the second with the same type of sire, a superior class of hackney, brougham, or cavalry remount.



TYPE OF HORSE FOR FIELD ARTILLERY.

No. 3810. Bay Australian Gelding. 6 years. Height, 15.1 Girth, $70\frac{1}{2}$ in. Shank, $7\frac{5}{8}$ in. Weight, 1,066 lbs.

To improve the bone of stock from weedy or inferior light mares, and impart substance and room, the type known as the Welsh pony might with advantage be used. These should tend to produce stout cobby animals, suitable for hack, sulky, or phaeton work, which would be readily saleable at remunerative prices.

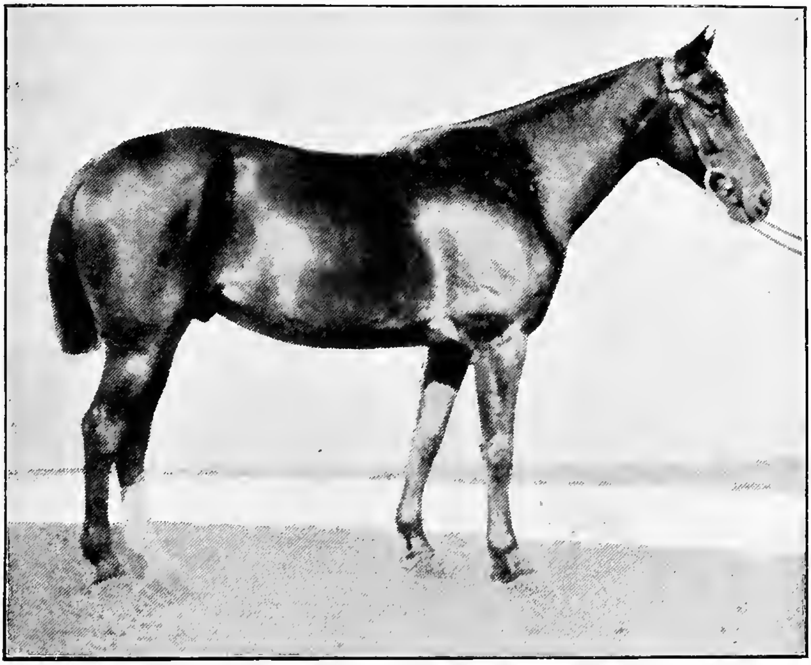
Another type of animal which is attracting considerable attention, not only in this State, but throughout the Commonwealth and New Zealand, is the American trotting horse. This is a thoroughbred in reality, in which the one pace has been studied through succeeding generations, and every effort has been strained to produce an animal which shall excel in trotting. Breeders have succeeded to such extent, that some of the record times put up by them compare so favorably and approach so near that of the racehorse that they seem almost mythical. Beauty of form has been preserved in this type of horse, which should nick in admirably with the better class of mare to produce a first-class animal.

What to Breed.

With the increased value of land, and the denser settlement of the State, horsebreeding cannot any longer be carried on on the same lines as formerly, as large tracts of country cannot now be spared to graze comparatively few animals. This being the case, it is expedient that breeders should endeavour to produce an animal, which, while competent to perform any work required, will at the same time, should they be desirous of disposing of it, command a remunerative price. Economy should be studied in this, the one animal taking as much to feed as the other, and the same care required during its early life, and until broken in. It behoves owners therefore to exercise their judgment (1) in having serviceable, useful mares, be they draught or hackney; (2) in the selection of a sire which will nick in and mate with such mares, so that the stock shall be a valuable asset, and not a drug on the market. The improvement of their stock should be their persistent endeavour, and, as charity begins at home, they should not send their mares to inferior stallions, either because their services are cheap or the property of a friend or neighbour. The expenditure of a little more money, or possibly sending their animal a little further from home, would allow of their procuring the services of a good stallion, as they are fairly well scattered throughout the State, and there are very few districts in which the services of a good animal cannot be procured at a reasonable rate. These animals cost their owners a lot of money, certain risks have to be faced, and it is only reasonable to expect they should receive fair recompense for the expenditure involved.

Indian Remounts.

Railways, motor-cars, bicycles, and other modern methods of locomotion having throughout the State lessened the demand for light horses, and the market for a surplus being India, it is to the interest of owners to cater for the requirements of that country. Such being the case, it is well to inform our readers what the principal types of animal are necessary to fill the bill of requirements. First, attention should be paid to what are required for Army purposes. These comprise—(*a*) animals suitable for horse and field artillery, and cavalry horses. The former class to be of a stouter type than the latter, as their province is essentially draught; but from the activity of movement required, heavy horses are unsuitable. From the report already alluded to, on page 4, it is stated:—"The Commission suggests that Australian breeders should be encouraged in future to breed the majority of the horses for the Indian market, as far as possible of one type—the weight-carrying hunter, of sufficient blood and undeniable substance, and of height from 14.2 to 15.1. It is not intended to lay it down that suitable horses of 15.2 should be refused, but as a general standard a height of 14.2 to 15.1 should be accepted for all horses. This type of horse should be defined as being specially strong in the following points:—Sufficient quality; balance, which can only result from a sufficiently true general conformation; depth of girth, and roundness and depth of back ribs; shortness of back; absolute straightness in fore legs as observed from the front, including the column of leg and its extremities to the foot itself; action decided and true all round." We are in a position to reproduce illustrations from above report of the class of animal required, and found suitable for the work of the Indian Army.



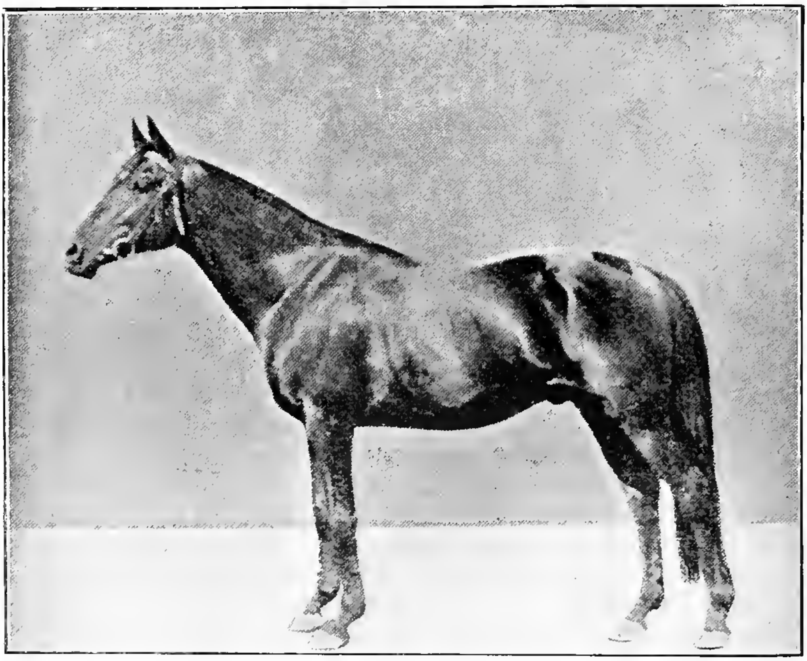
TYPE OF HORSE FOR HORSE ARTILLERY.

No. 3642. Bay Australian Gelding. Age, 6 years. Height, 15.2. Weight, 1,196 lbs.

A good demand also exists in that country for smart, active, clean-limbed ponies, but they must possess quality in a pre-eminent degree, as long prices will not stop prospective purchasers, but in return they demand quality, and, being prepared to pay for it, are entitled to it. It is within the power of Australian breeders to supply the class of animal asked for, if they will. The country favours the development of such an animal, and breeders should exercise their judgment in the selection of sire and dam calculated to produce what is wanted.

Type of Sire.

Here again we are fortunate in being able to reproduce an illustration of the type of thoroughbred favoured by the Commission, and the original of which appears in their report. This animal is at the stud on one of the Government farms used for horse-breeding in India, and our readers can readily detect how well calculated such a class of animal would be to nick in with the class of mares to which attention has been drawn. But in the selection of a sire to mate with such dams, it would be well perhaps to draw breeders' attention to a few points to be avoided, such as constitutional defects, whether of limb, barrel, or of form; *e.g.*, ungainly head, long neck, drooping narrow hindquarters, legginess, misshapen hock, shallow back ribs, fore limbs standing too far under, weak pasterns, long and necessarily weak couplings at the loins. Never mind what strain of blood an animal having any of these defects is supposed to possess, he is not one fit to use as a sire, and should have been castrated, as his services would be dear if had for nothing. That the absolutely perfect animal is well nigh non-existent is an acknowledged fact; but it is advisable when selecting a sire to choose one possessing the fewest faults. Such a one should stand well up in front on sound legs, with evenly turned hindquarters, giving the animal a well-balanced appearance; possess roomy chest, well-set sloping shoulder, short barrel, well and closely-knit by deep hind ribs and short coupling to hind quarters, which in turn should be well and squarely set; good nostrils; eyes on neatly-shaped and well-set head should not escape attention. The former, it must be remembered, are channels through which inspiration and respiration are performed, and consequently should be roomy. To the latter more attention should be paid than is generally done, and many an otherwise good animal, through defects of vision, becomes not only a nuisance, but a positive source of danger, whether as a hunter, hack, or for driving purposes. The Indian climate is much more trying to the constitution of the horse than that of Australia, a fact of which Indian horse judges are well aware, and they therefore subject animals before purchase for the Army to most searching examination for visual defects. The neatly-formed head should be linked with

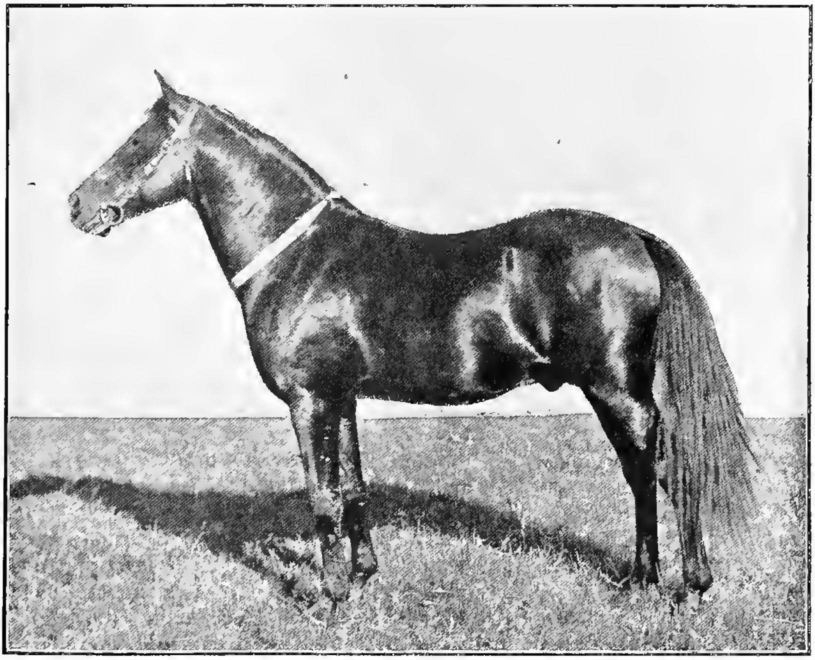


TYPE OF ARAB STALLION REQUIRED.

"Sahib."—Bought under orders of Government of Bombay by Superintendent C.V.D., Bombay.

the well-rounded barrel by a neck of graceful proportions and fair length, so that it may present an arched appearance when the animal is holding up its head.

So far attention has been directed only to the thoroughbred stallion which should serve to form the first cross with the draught mare of the class already described. With the mare the produce of this cross, again crossed with the Arab stallion, the foal should prove an animal capable of doing any amount of work up to weight carrying and command a high price. On the point of utility of desert-born Arab stallions, on page 18 of the report the following recommendation occurs:—"The majority of Imperial stallions should be thoroughbred English or Australian, the rest being Arabs of true desert type." A reproduction of an illustration of the type of such an animal at the stud in India is given. The diffusion of Arab blood with the cross specified of thoroughbred stallion and clean-limbed, active draught mare would tend to correct any grossness, and render the contour graceful, while keeping down legginess. Through the courtesy of Mr. A. J. Fisken, "Lal Lal" Estate, Yendon, I am enabled to offer a reproduction of his Arab stallion, "Desert Born." He is a dark bay, with black points, and stands 13.3 in height. Reference to the illustration will show he is possessed of abundance of bone and substance, while he presents every indication of quality in all respects. Prior to his being shipped from India, where he had won many races previously, he carried 13 stone 2 lbs. to victory over a course well nigh a mile in length against first-class company, in good time. The wisdom of securing such an animal is evidenced by the fact that his



ARAB STALLION "DESERT BORN."

Height, 13.3 Winner Champion Prize, Royal Agricultural Show, Melbourne, 1904.

services are in strong demand throughout the district in which he is at the stud, and his stock have been successful against large fields in the show ring where exhibited. No doubt there are several other Arab stallions at the stud in various portions of the State, whose value is equally appreciated and patronized by breeders in their respective districts.

In addition to the already described purpose for which such a stallion is valuable, he should beget good ponies—those suitable for polo work—from the lighter kinds of mares; while from the stouter class, those suited for weight-carrying or fashionable animals for driving purposes. Direct with a clean-limbed, active draught mare, a stout cob, with plenty of action, should be the outcome, if there still remains any truth in the adage, "Like should at least beget like."

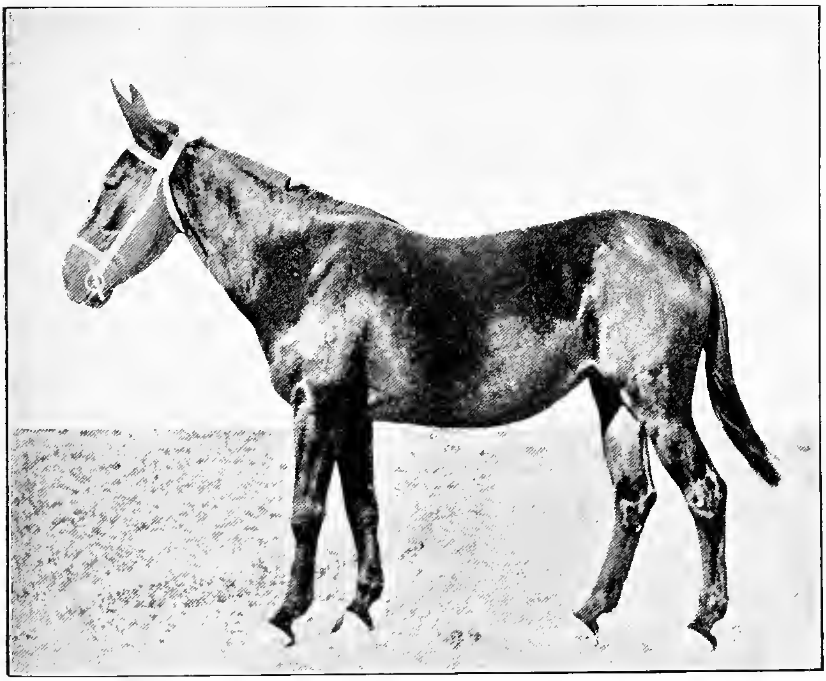
In reference to the Arab stallion, it must be born in mind the desert-born Arab is the type specified; and, quoting again from the report to which allusion has so frequently been made, we find, in connexion with some of the so-called Arab stallions in the Imperial studs in India:—"Of the so-called Arabs, two-thirds are not Arabs of the desert at all, and, whatever may be their merits as horses, they have very little Arab type, and are unsuited for Indian breeding." Now, if they are no use in India, how can they be expected to prove of much use in Australia, and consequently should be relegated as composite and nondescript, and not worthy of consideration. The desert-born Arab is intrinsically and essentially as much a pure bred as the thoroughbred, hence it is that his lineage asserts itself in such a marked degree in the stock got by him. In the hope that the perusal of this paper may induce breeders to exercise every possible care in the selection of sires, from which they are to add not only to the national wealth of the State, but to their individual gain, I shall now conclude, feeling convinced that there will be ample discernment on their part to know there was sufficient reason for its issue.

MULE BREEDING.

When inquiring into the causes of deterioration in Australian horses some years ago, and thinking over the possible methods of making a general improvement, it occurred to me that, as a side issue, mule breeding might be made a payable industry, and at the same time do a great deal towards preventing the breeding of unprofitable horses. In other words, I fully recognised the fact that it is essential to stop the breeding of unsound, worthless animals in order to encourage improvement in the general character of the horses produced. Perhaps it would not be out of place here to briefly summarize the causes of deterioration in order that the suggestions I have to make may be seen in their proper perspective.

In the early colonial days Australia deservedly had the reputation of producing the finest horses in the world. Only the best stud animals were introduced, and, there being no inferior indigenous races to contaminate the breed, and the climate and soil being all that could be desired, horses throve and multiplied till they soon outran the local demand, and became of so little value that breeders became careless in mating their sires and dams, and failed to castrate their young colts or separate the sexes, with the result that a rapid deterioration at once set in, just in the same way as when horses, allowed to run wild, no matter how good the country may be, invariably deteriorate in size, form, and quality.

When the Indian trade sprang up horses became more valuable, and for many years the supply was equal to the demand, but with the continual drain of the best stamp (and especially when mares were taken, leaving the culls to breed from) the industry went from bad to worse. The continual change in the stamp of horses required also led to experimental crossing of breeds to restore the lost size and substance, which resulted in the production of a large number of nondescript animals. To such an extent has this gone on that, with the exception of thoroughbreds and draughts, we can scarcely find any distinct class or breed. Restricting the larger breeding areas of former years, together with periods of drought and scarcity of feed, have also been factors; but of all the causes, the uncertain values have had more to do with discouraging breeders than anything else. Had all the inferior and unsound animals been destroyed or prevented from perpetuating their faults when the equine population became too great for local requirements, and had this policy been rigidly adhered to, Australia would still have held its prestige as a horse-breeding country.



TYPE OF COUNTRY-BRED MULE. HEIGHT, 14·2½IN.; GIRTH, 69IN.
(Indian Horse and Mule Breeding Commission Report.)

But, in spite of all these drawbacks, there does not appear to have been any great falling off in the number of animals bred, but the proportion of unmarketable and consequently unprofitable ones is something appalling. There are thousands of light horses that are not worth an average of £5 each, which have cost as much to produce as £20 horses, and, on account of being unsaleable, are kept on eating the grass that might be put to a better use.

It may be safely stated that 50 per cent. of the mares at present breeding are, either through defects in form, size, or soundness, unfit for the purpose, and that many of the stallions are similarly afflicted. Assuming that a suitable scheme of encouraging the breeding of good, sound, serviceable horses can be adopted, such as registering and subsidizing good stallions, and using only approved mares, the question arises, can we profitably utilize any of the rejected mares? To this I unhesitatingly answer Yes. Many of them could be used for breeding mules. In the United States and many other countries mule breeding is a most extensive and profitable industry. Why should it not be found equally profitable here? In 1889 America sold 330,000 mules, of which number Missouri furnished 68,000, Kentucky 50,000, Tennessee 56,000, and other States in proportion, the sales being greater in proportion to the number bred than that of any other kind of live stock.

Why Mules should be Bred.

Mules do not inherit unsoundness from their dams to the same extent that the progeny of horses do; they are more easily reared, and are fit for work at an earlier age than horses. They are more suitable for farm work, packing, &c., and have a much higher value for export than all but a few special lines of horses. Mares unsuitable for horse breeding would breed good, sound, marketable mules.

I do not wish it to be inferred that it is desirable to use only unsound or rejected mares, but to point out that many defects that are transmitted to horse progeny are not so transmitted to the mule, and what is still more important, any defect that a mule may have goes no farther, as they do not propagate. It must be quite self-evident that the better the dam the better the mule, and I am quite confident that when farmers find out the real value of the mule some will prefer breeding him from good mares to running the risk of breeding unmarketable horses. To put the matter in another way, the small farmer who breeds half-a-dozen good mules from his plough mares will make more money and feel better satisfied than his neighbour, who tries to breed half-a-dozen draught or crossbred foals. The mule, it must be remembered, has always a good export value, which the draught horse has not, so there is not the likelihood of glutting the home market with the former that there is with the latter. I have, therefore, no hesitation in saying that, if the Government introduced a number of suitable jacks, and distributed them among the small farmers, and allowed them to stand either free of charge or at a nominal fee, fewer mares would be sent to inferior, weedy stallions standing at small fees. There are dozens of men who would not object to pay £400 or £500 for a good thoroughbred or other suitable stallion were it not for the fact that if they charged a payable service fee some one would immediately come along with a broken-down £25 screw and travel him at a fourth the fee. This latter class of animal is the one that the jack would replace, and no harm would be done to any one. In a few years, instead of having the country filled with useless weeds, we should have a valuable asset in a number of mules worth from £15 to £25 each, either for home use or export. The cost of breeding a mule is about half that of a horse. He will live and thrive where a horse would starve. He is less liable to accident or disease, will work at an earlier age than a horse, and last three times as long. Three working mules can be kept at the same cost as two draught horses. They can drag as heavy a load, work longer hours, and if tired a feed and a night's rest make them as fresh as ever.

Many people think the mule stubborn and vicious. Stubbornness is certainly his characteristic, and an admirable trait it is. It is this that makes him try and try again till he shifts his load, and he will keep this up long after the best horse has given in. Viciousness is rarely met with, and is generally the result of ill-usage. He is not naturally so, and with fair play and kind treatment he is a more docile and intelligent animal than the horse. If a mule runs away, or a number should stampede, you will generally find them feeding unconcernedly on the nearest patch of good grass; and if one should get entangled in his chain, or fixed under an upturned waggon, he will lie quietly till he is extricated. A runaway horse is as likely as not to kill himself by running blindly into the nearest obstacle in his mad career; or if entangled in any way, to kick and struggle until he breaks a leg, or does some other serious damage to himself.

Mr. J. L. Jones, of Columbia, Tennessee, a well-known authority on mule breeding, says:—"There is no kind of labour to which a horse can be put for which a mule may not be made to answer, while there are many for which mules are more peculiarly adapted than horses; among the rest, that of mining, where the mule is used, and many of them need no drivers. The mule is better adapted for carrying burdens, for the plough and agricultural machinery, building railroads, and, in fact, all kinds of heavy work. I have driven a 16-hands mule, out of a thoroughbred mare, in a buggy with two men and baggage 32 miles in four hours, and she was quite fit and ready to go on."

JACK, MARE, AND MULE FOAL.

Kinds of Mule.

There are two kinds or classes of mule, viz., one the produce of the male ass, or jack, and the mare; and the other the offspring of the stallion and female ass or jennet. The cross between the jack and the mare is properly called the mule, while the other, the produce of the stallion and jennet, is designated a hinny. The mule is the more valuable animal of the two, having more size, style, finish, bone, and, in fact, all the requisites which make that animal so much prized as a useful burden-bearing animal. The hinny is small in size, and is wanting in the qualities requisite to a great draught animal. This hybrid is not supposed to breed, as no instance is known to us in which a stallion mule has been prolific, although he seems to be physically perfect, and shows great fondness for the female, and serves readily. There are instances on record where the female has produced a foal, but these are rare.

The mule partakes of the several characteristics of both its parents, having the head, ear, foot, and bone of the jack, while in height and body it follows the mare. It has the voice of neither, but is between the two, and more nearly resembles the jack. It possesses the patience, endurance, and sure-footedness of the jack, and the vigour, courage, and strength of the horse. It is easily kept, very hardy, and no path is too precipitous or mountain trail too difficult for one of them with its burden. The mule enjoys comparative immunity from disease, and lives to a comparatively great age. Pliny gives an account, taken from Graecian history, of one that was eighty years old, and, though past labour, followed those that were carrying material to build a temple. Dr. Reese mentions two that were seventy years old, in England. Mr. J. L. Jones knows of a mule in Middle Tennessee that, when young, was a beautiful dapple grey, but is now thirty years old, and is as white as snow. This mule is so faithful and true, and has broken so many young things to work by its side, that he bears the name of "Counsellor." The last time he was seen by Mr. Jones he was in a team attached to a reaper, drawing at a rate sufficient to cut 15 acres of grain per day.

The kind of Sire to Breed from.

There are two kinds of jacks, the mule jack and the jennet jack, or combined jack, that is good for either mares or jennets, and is used chiefly in breeding jacks for stock purposes. It is only with the mule jack that we will deal, as the jennet jack is too costly to breed to mares, as a rule, unless the mares are of extra quality.

A good mule jack ought not to be less than 15 hands high, and have all the weight, head, ear, foot, bone and length that can be obtained, coupled with a broad chest, wide hips, and with all the style attainable with these qualities. Smaller jacks often produce good mules, and when bred to large roomy mares show excellent results. Black with light points is a favourite colour, but many grey, blue, and even white jacks produce good mules. In America many varieties are to be met with, viz., the Catalonian, Andalusian, Maltese, Majorca, Italian, and Poitou, as well as a native jack. Of these, the Catalonian is considered the best. He is of good colour, possesses clean bone, and runs from 14½ to 16 hands. though he rarely reaches the latter. The Andalusian is about the same size, but of worse colour. The Maltese rarely exceeds 14½ hands, but is of fine quality. The Majorca is the largest, and frequently grows to 16 hands. The Italian is small, but a remarkable good breeder. The Poitou runs about 15 hands, and has heavy bones, long hair, and a good foot. The Kentucky jack, on account of the good grass and limestone formation, grows to a large size, and is preferred by many breeders to any of the imported varieties. These would probably form the best sires for Australia.

The kind of Mare to Breed from.

As already pointed out, the better the mare the better the mule, for it is found that the latter partakes very largely the body and shape of its mother. But while always preferable to have a sound sire and a sound dam, there are many mares, and especially farm mares, with slight side-bones, or a tendency to ring-bone, or flat-footed, which, though unsuitable to breed to a draught or weedy thoroughbred stallion, would breed good useful mules, for these would not appear in the mule. As the mule is required for draught rather than speed, and increases in value with every inch of his height, and every pound in weight, it would be undesirable to use too weedy mares. It has been stated that the reason that farmers dislike breeding light horses, and prefer draughts, is that the latter can be put to work at 2½ years old, and the mares worked at slow farmwork while in foal, whereas this cannot be done with the lighter breeds, which are a continual source of expense, and earn no part of their livelihood until sold. What applies to draught horses equally applies to mules if the right sort of mares are used.

Rearing the Mule.

While the mule is capable of foraging for himself where an ordinary horse would starve, it is equally true that, with good feeding and kind treatment, he grows into a finer and more valuable animal. The young mule can be weaned at four months old, and will do well for himself if grass is plentiful, so that the dam need not be idle more than half the year; in fact, if well cared for, and only used for slow work, she may be almost worked the year round. At two years old the mule is easily broken. When accustomed to the feel of the harness, if he has already been broken to lead, he will take his place alongside a broken mule or horse, and go to work, and, if well-fed, will do his share.

Market for Mules.

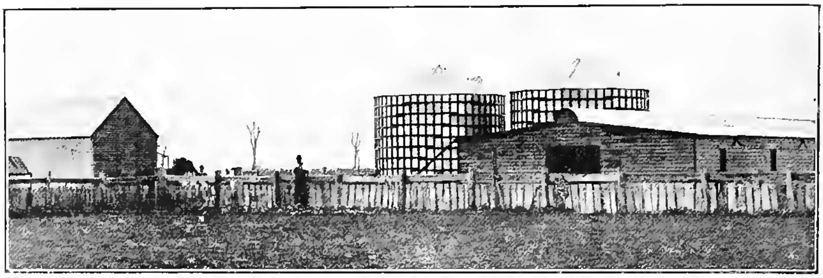
When speaking on this subject at the Farmers' Convention at Colac two years ago, I was asked by a farmer if I thought any one would buy a mule if he bred one. My reply was that if he bred one and worked him he would not want to sell him, but would lose no time in breeding more for himself or for sale. With proper encouragement to start it, mule breeding will soon take care of itself; and whenever the local demand that will arise, when the true value of the animal is known, becomes supplied, and that will not be for many years to come, there is a ready market in India and other countries for all we can supply.

Conclusion.

In making comparisons between the horse and the mule, I do not wish to disparage the former, which I think the most beautiful, as well as the most useful, animal that has ever been domesticated by man. My only desire is to show that the patient, plodding mule possesses potentialities that are little dreamt of by the majority of Australians. For the explorer, the gold-seeker, the pioneer selector in the Gippsland or Otway Ranges, where vehicular traffic is impossible, or the struggling wheat-grower in the innermost Mallee fringe, the trusty mule is the animal *par excellence* to share his toil, and will well repay a trial.

CHAPTER XV.

DAIRY FARMING.



PREPARATION OF THE LAND.

A few points to be considered in the taking up of land are its closeness to markets, accessibility to roads or railways, and its general suitability for the purpose for which it is intended to be used. There must be a sufficiency of the area suitable for cultivation purposes. A portion, at least, should consist of slightly rising ground, so as to provide a dry camping place in winter for the stock. A high dry position with proper drainage is essential for the settler's dwelling and farm buildings.

Assuming the land selected is forest land, the first thing to be done is to set about ridding it of undergrowth and timber, as far as practicable, in order to enable the selector to put it under grass. To a great extent, he must be guided by the nature of the country, and the vegetation growing thereon. As a rule, the experience of earlier settlers will be the best guide.

Clearing Scrub.

To get the best results, all timber that is not fit for splitting or milling should be ring-barked from twelve months to three years before cutting the scrub, during which time the bark and a lot of the small branches will be in a fit state to burn, and will be got rid of when the scrub is burnt, and save many pounds' worth of labour and grass seed in years to come. It will be necessary, however, to cut and burn a portion of the scrub as soon as possession is obtained, so that some may be put under grass for a small dairy herd, to provide returns at an early date. It is best to start cutting the scrub at the north end, if the aspect is to the north, and lay it all one way, so that it will lie close to the ground. It should be cut less than a foot from the ground for the same reason, and also that the stumps will not be high enough to be a trouble after the burn. Saplings up to from 2 to 3 feet should be cut, and occasionally one may be laid across the scrub to press it down low to the ground. The closer to the ground, the better will be the burn, often to saving of pounds per acre in picking up. All saplings that are off the ground should be lopped. Heavy scrub should be cut at least four months before burning. March is the month fixed by law for burning; a hot north-wind day is the best time to light the fire. The scrub and ground should be thoroughly dry, so that the leaves will carry the fire. As soon as convenient after burning, the timber still remaining unburnt should be cut into convenient lengths for handling, piled into heaps, and burnt.

SOWING GRASS SEED.

After the burn, in the autumn is the best time to sow the grass, and the ashes make a splendid seed-bed. The best grasses to sow are a mixture of rye-grass (perennial) 15 lbs.; cocksfoot, 15 lbs.; foxtail, 2 lbs.; timothy, 2 lbs.; cow grass 1 lb.; white clover 1 lb.; lucerne 3 lbs.; alsyke 1 lb.; crested dogstail, 1 lb. This mixture will cost about 20s. per acre. In swampy land, the best of all is strawberry clover, roots planted 3 feet apart each way. Lucerne and prairie grass are the two most valuable of grasses; but these must be sown in paddocks after subdivision, as they will not stand grazing too closely, and must be spelled regularly, or will be eaten out altogether, and they will not succeed everywhere.

STOVING OUT.

When preparing land for cultivation, the cheapest and best means of getting rid of stumps is by what is called stoving out. The earth is cleared away round the foot of the stump, a layer of small wood placed close all round to the depth of about a foot or 18 inches, then covered with the turf and earth in such a way, if possible, to prevent it falling in after the small wood is burnt up from underneath. The small wood is lighted, and when properly started, cover the fire over entirely, keep it from breaking out, and the stump will smoulder away.

SUBDIVISION.

One-fourth or one-fifth of the area should be set apart for cultivation to raise fodder crops for summer and winter feeding. The remaining portion should be further subdivided to enable a change of pasture to be given the cows frequently. Close grazing and confinement to the one pasture has a tendency to sourness or staleness, or makes the land what may be termed cow-sick. It may not be found convenient at the commencement to go to the full extent in this direction, but the grazing land should at least be divided into two paddocks. Dairy cows appreciate a change of pasture frequently. The grass also benefits, as it gets a chance to become better established and sweetened. A small paddock of one or two acres should be fenced in for calves, and another for pigs, convenient to the milking shed. These paddocks may be laid down either in lucerne or clover, and shelter sheds, with dry warm bedding, provided.

BREEDING, FEEDING, AND MANAGEMENT OF CATTLE.

We have now arrived at a stage when the advice tendered may be applied to the settler who is taking land that is already cleared, as well as to the selector. One of the greatest mistakes made by inexperienced settlers is the practice of overstocking. Twenty cows well fed will produce as much butter as thirty cows half-fed, and with only two-thirds of the labour in milking and tending. The point to be considered is what quantity of fodder, either grass or other fodder crops, will an acre of the land in question grow in the year. Good land, similar to the best Western District, will, it is said, carry a cow to the acre. The amount of grass required to keep a cow for one year is estimated at about twenty tons, including waste. It is, therefore, safe to assume that this is the amount of grass grown on an acre of the land mentioned for one year. It would not, however, be safe to stock a farm to this extent and depend on pastures alone. The yield of fodder per acre can be considerably increased by growing maize and other heavy yielding crops, in consequence of which the carrying capacity would be increased. It is wiser to have too few than too many cows, and to have only the best procurable.

It will generally be found advisable to commence by buying the whole herd of a dairyman who is giving up dairying. Where this can be done there is a great saving in time and expense, besides guaranteeing at least a proportion of good cows. Failing this, buy springing heifers from a noted dairyman. Wherever possible, good cows should be procured. Buying indiscriminately in the public yards is not the way to build up a good herd. One good cow is better than three bad ones, hence the necessity of procuring the best cows possible, no matter at what price. If it is compulsory to buy the cows for stocking at the public sales, the following descriptions may be found useful to the inexperienced. External appearances, however, are not always infallible, but will help to some extent.

GENERAL APPEARANCE OF COW.

Head carried well up, and set on a fine flat neck, moderately thin through the shoulders, deep body, well sprung ribs set wide apart, good length of body, large barrel showing plenty of room for digestive organs and a capacity for consuming a large amount of food, a lean back and broad hips or wedge-shaped conformation. The cow should be of a quiet disposition, submitting kindly to handling of teats and udder. Udder should be proportionately large to the size of the animal, not fleshy; teats of a medium size, and squarely set on the udder; milk veins prominent, and running well forward, terminating in large milk wells. A good constitution, and freedom from all evidence of disease or unsoundness are points of considerable importance. The Babcock test and scales are the settler's friends, by means of which he can readily determine the value of the individual cow of his herd.

SELECTING A BULL.

A great deal of the settler's attention should be given to this subject, as it is of equal importance to the buying of good cows. A good herd of dairy cows can be built up from medium cows by using a bull from a known butter-producing family, and each heifer calf reared will be an improvement on its mother from a dairy stand-point. If the bull is not carefully selected, or of the right sort, the reverse is the case. Conformation of the bull cannot be taken as a guide to purchase, nor even a pedigree alone. First ascertain the performances of his antecedents at the milk pail, and if satisfied that he is one of the right strain, then external appearance may be taken into consideration. It is not recommended that a nondescript animal, or one showing beef-producing tendencies, though coming from a good milking strain, should be introduced into the herd. The bull should be possessed of a good constitution, and of masculine appearance, and should not be too heavy about the fore-quarters and withers. He should be fine in the bone, have well-sprung ribs, showing depth through the heart, deep barrel, straight along the back, tail squarely set on, fine, and reaching well below the hocks, rudimentary teats well developed and of a brown colour, good escutcheon, and a docile disposition.

A bull should be taught to lead by a ring in his nose before he is a year old, and when turned a year old may be allowed to serve a few heifers. He should always be in good condition, and this applies to all young stock. They should never be allowed to fall low in condition, or they receive a check from which they never recover. Bulls, when required for service (and this applies to sires of all classes) should be liberally fed on food rich in protein, such as clovers, lucerne, bran, beans, peas, &c.

It is sometimes found that females will not hold, in which case change of sire, a dose of salts, exercise of both bull and cow, flushing the womb with Lysol solution, &c., may produce the desired effect. Lack of exercise is found to be one of the chief causes of failure to breed, lowness in condition being another. Only the best animals should be used for breeding, always bearing in mind that "Like begets like." This is the first law of breeding, but at the same time this may be over-ruled by impurities in the blood. The purer the blood, the more certain the result is to be satisfactory. Cross-bred sires should never be used, as they are very likely to reproduce the worst faults of both families. By using a pure bull an inferior herd will be vastly improved in a few years. It is not sufficient, however, to have purity of blood alone, for the bull's ancestors must have been good butter producers. Twenty pounds or £30 paid for a bull is nothing compared to the value of the improvement he effects, for inferior cows are worth only £3 to £5 at best, but first class dairy cows can be sold readily at from £12 to £20.

The breed of cow is not of so much importance as the individuality, for in almost any breed first class butter producers are found. The recognised dairy breeds, however, in this country, are the Shorthorn, Ayrshire, and Jersey, and there are a few herds of Holstein and Kerry. There are some first class herds of milking Herefords, but the best individual cows are among the first four breeds named, and particularly crosses between those breeds, the best, perhaps, being the Shorthorn-Ayrshire or Shorthorn-Jersey cross. A point to remember is that a cow must be bred, not made, although the best may be spoiled through not being properly fed. The amount of butter she will produce depends firstly on her own individuality, and then on liberal feeding, for no amount of feeding will materially alter the quality of a cow's milk as far as the percentage of butter fat it contains is concerned, but feeding will increase the quantity.

AGE AT WHICH TO BREED.

A dairy farmer should always as far as possible breed and rear his own heifers, paying the greatest attention to selecting the calves from the best butter-producing cows. This applies both to heifers and bulls. There is less risk of introducing disease, and generally a man can produce animals of better quality than he can buy in the market. The milking powers of a herd can be vastly improved in a few years by this means. To fill up the places of old cows and those that prove unlucky, or unprofitable, young heifers, to the number of one-third or one-fourth of the total of the herd, should be available each year. The time at which heifers ought to bear their first calf depends a good deal on how they have been reared, which, needless to say, should be as well as possible. Everything possible should be done to develop the frame, as it has been proved that the largest animals in any particular breed are the most economical producers of butter. Then, provided heifers have been well reared, they can be put to the bull at a year and nine months' old, so that they would calve about two and a-half years old. Some breeders like them to come in at a year and nine months, or two years, and then milk them on as long as they will, and let them have a season's spell. Any way, the aim should be to develop the frame to give large digestive capacity.

Heifers, after their first calf, should always be milked for as long a period as possible, say ten months, even if only stripping, and never allowed to go dry about six months after calving, as they often will. This encourages a most valuable habit, that of persistent milking. A cow should never be dry more than six to eight weeks out of the year, but requires this time to regain strength for the following season. A good cow would often milk up to the time of calving, but, if allowed to do so, will not produce as good results the next year. She must be dried off systematically, first by milking only once a day, then once in two days, then say twice a week until perfectly dry. Great care should be taken not to finally turn her out until the udder is perfectly clear, or the loss of a quarter may be the result. A cow should not be put to the bull before five or six weeks after calving. A cow does not come in season when in calf as a rule, at other times every three weeks. It has been noticed that in the early stage of tuberculosis, they sometimes come in season after they are in calf. When a cow is in calf four or five months, the fœtus or calf may be felt by pressing the point of the thumb into the right flank. The following is said to be a reliable test:—If a cow is in milk, get a glass of water, and with a straw or glass tube, drop a drop of milk into the water. If the milk mixes with the water immediately, the animal is not in calf; if the milk hangs together and settles, the cow is in calf. Pregnant cows should be kept in good condition. One of the greatest mistakes made by our farmers is to allow cows to get low in condition during winter. In such cases, two or three of the best months of the year are wasted in laying on condition, which should never have been lost, when they should be putting it into the bucket. That is not the way that records, nor yet payable returns, are made. When cows are in good condition, they should, about three weeks before they are due to calve, be placed on short feed, either on a poor pasture, or a week before calving, be shut up in a yard for a time, and should have the following dose:—12-16 ozs. Epsom salts, according to size of cow, ½-1 oz. ground ginger, ½ lb. treacle in warm water or gruel. (This dose should be the farmer's stand-by, and whenever a cow shows signs of being the least out of health, if this is administered, more serious trouble will be very often warded off.) This is to guard against "Milk fever," which will be dealt with later.

In calving, a cow should not be interfered with too soon. In ninety-nine cases out of a hundred, she will calve naturally and without assistance; but at the same time, she should not be left long enough to exhaust herself before assistance is given. The calf should appear two front feet first and the head, nose first, lying along between them. Sometimes the hind legs may appear first, and in this case, it may be taken away, but at times the head may be doubled back, the rump may be presented first, the calf may be on its back, &c., and in these abnormal presentations, the calf must be forced back and turned so that either the fore or hind legs are presented first. Sometimes it will be found necessary to raise the hind quarters of the cow by means of a block and tackle, and rope fastened round hind legs of the cow to take the weight back, so that the calf may be turned. When the hand and arm have to be inserted, they should be lubricated with carbolic oil, in which is mixed a little laudanum. The cow should be raised immediately after calving to prevent straining, and this too may be stopped by injecting carbolic oil and laudanum into the womb. If she is much exhausted, a bottle of wine or beer or a quarter pint of spirit may be given and repeated in twelve hours, if necessary. Should the afterbirth not come away, liquid extract of ergot should be given in ½-oz. or 1-oz. doses in warm gruel. A "cleansing" drench—1 lb. Epsom salts, 2 ozs. sulphur, and 1 oz. ginger—may also be given. The womb should be irrigated or flushed by means of a piece of ½-inch rubber hose about 4 feet long, to which a funnel is attached, using a solution of Lysol (2 parts Lysol in 100 parts warm water). It is always wise to flush the womb with this solution, and wash the hind quarters with the same.

Water.

Next in importance to feed is water, which should be supplied as pure as possible, in abundance, and in a convenient place, so that cows can get to it without much exertion. If they do not get a sufficiency of water they cannot produce so much milk. If it is much trouble to get they will only go for it when compelled by thirst. Springs and rivers are the best source of supply. Where dams have to be used they should always be fenced in, so that the cattle cannot get into and dirty the water. Besides foul water being a source of contamination, producing taint in the milk, cows will not drink so much, and so will not produce so much milk. The water should be pumped from the dam into troughs, the windmill being the best means of effecting this. If the dam is at a suitable level the trough may be below and the water conveyed by syphon, having a ball tap in the trough. Wherever possible the approaches to the water supply should be clean, so that dirt mixed with manure does not get on to the udder, as this is found to be one of the most frequent sources of taint.

The Cow at Grass.

The farm should be subdivided into a number of suitable paddocks, so that the milking cows do not run for more than a week on one paddock without a change, as through constantly walking over it the grass becomes soiled and distasteful. Consequently the cow will not eat so much as when it is sweet, as is the case when changed to fresh paddocks. The land must be kept free from strong smelling shrubs and herbs, such as dog-wood, penny-royal, &c., which when eaten taint the milk. The animals should be looked upon as being the means of converting valuable vegetable products of the farm into more valuable animal products, and so the more an animal consumes the greater will be the conversion, consequently the profit. A cow of about 1,000 lbs. weight can eat 100 lbs. of grass, or its equivalent, per day, and it takes 60 lbs. of that to keep up the system, that is, the temperature and repair waste of tissue which is consequently taking place. It is only what is eaten over that 60 lbs. which goes to produce profit in the form of either meat or milk. Then if a cow only gets 80 lbs. of feed she is only producing half the profit she is capable of.

From this it will be seen the necessity for providing abundance of feed in some form or other, and the folly of keeping more cattle than can be fully fed.

BRINGING THE COWS TO BE MILKED.

Anything that unduly excites the cow will be to the detriment of both quantity and quality of the produce. This may often be noticed when the records of weights and tests are made, and, apart from this apparent variation, there is sometimes a chemical change effected in the milk, and it has been noticed that the milk from a cow that has been thrashed, when added to the milk of the herd, has spoilt the whole of it. The necessity of handling the cows as quietly and carefully as possible will, therefore, be seen. If dogs have to be used, they should be thoroughly under control, and on no account should a cow be subjected to ill-usage, nor hurried from the pasture to milking yards. It is a great mistake to milk too many at one place, 100 or 120 being quite enough, and where more are to be milked separate sheds should be provided. Where too many are milked at one place, too much time and exertion, which mean food, are wasted in travelling and delay.

The cows should be brought to reasonably clean yards to be milked. Of course, where there are cows there is bound to be dirt, but every possible effort must be made to keep that dirt out of the milk. Particularly should there be no accumulation of dry, dusty cowdung in summer, which gets stirred up with every movement of the animals and every breeze, and so gets into the milk. The cow sheds and bails must be regularly limewashed. This helps to keep the place sweet and also to keep away flies. Cows may be milked in the open paddock or yards just as well as sheds, and in this way save the cost of building sheds for some time if not convenient. Wherever there are sheds and yards, however, they must be kept clean and sanitary.

MILKING.

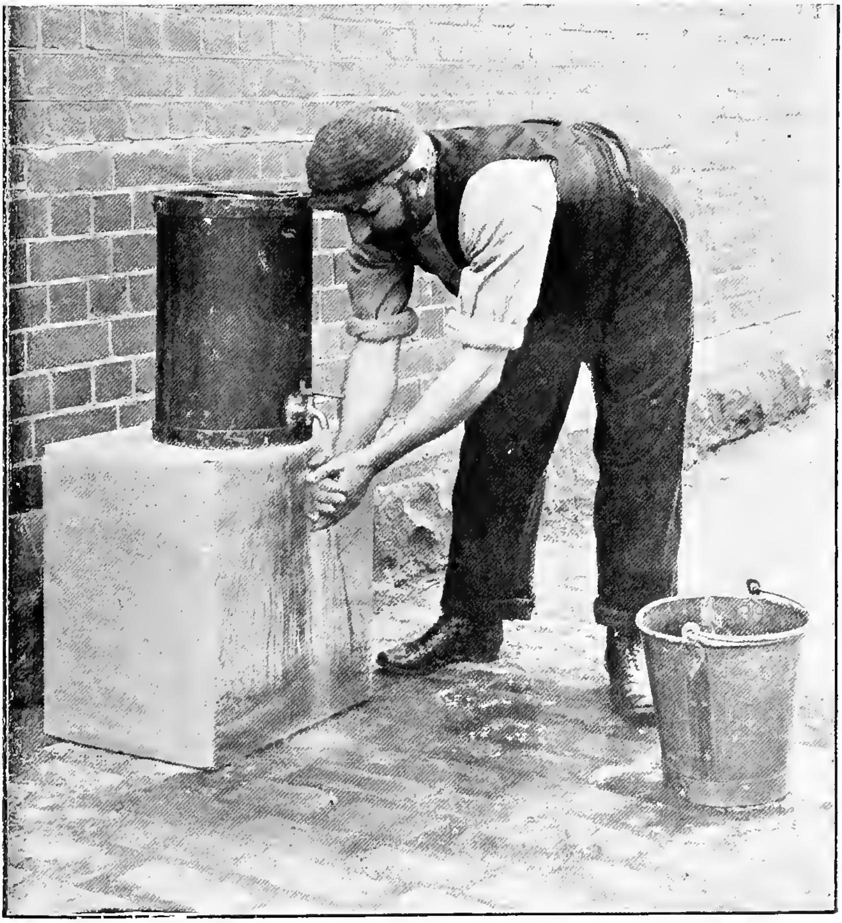
The cows on being bailed up must be prepared for milking by having dust and loose hair, &c., brushed off their flanks, and the udder washed clean, if dirty, and in any case the teats and udder should be wiped with a damp cloth rung out of clean water in which is some disinfectant, carbolic or boric acid being the best.

The water for cleansing purposes should be kept in a tank in a convenient position. A very good method where water is not laid on is a 10-gallon oil drum with a tap in the bottom. [See illustration.] The cloth being held under the tap only clean water is used, and not, as we often see, a billyful of water having to do for a large number of cows, in which case, after two or three cows have been washed more dirt is being put on the udder than is taken off. Again, the hands of the milkers must be washed after every two or three cows, and in case of sore teats or diseased udders after every cow. The disinfectant in the water will prevent the spread of disease from one cow to another. Nearly all these troubles are caused by germ life, which is destroyed by the disinfectants.

The milk should be taken from the cow as quickly as possible, the cow being milked perfectly dry, as the last of the milk is almost pure cream, the first portion being of very poor quality. Great care must be taken not to allow any milk from an injured or diseased udder getting into the bucket. In case of sore teats a dressing should be applied as soon as the cow is milked. The following will be found most suitable:—One part pure carbolic acid, one part glycerine, ten parts vaseline.

STRAINING.

Immediately the milk is taken from the cow it should be weighed, sampled and the weight recorded on the sheet—(see article on testing)—and then strained through at least two folds of butter muslin. A wire-strainer alone is not sufficient, as will be understood by reference to the illustration of milk-strainer, for a lot of fine dirt passes the wire and is caught by the muslin. The milk must then be immediately conveyed to the dairy or separator-room.



HANDY CONTRIVANCE FOR WASHING HANDS AND CLOTH.

Calves.

REARING.

A calf must have its mother's milk or beestings for at least five days from birth. This acts as a medicine, and puts the stomach in a healthy condition, besides being very nutritious. The milk must not be used for butter or cheese-making for at least five days, or until all traces of beestings have disappeared. Calves should have new milk for three weeks, and then half new and half skim for a week, when they may be finally put on to skim with which is mixed some substitute for the fat which has been removed. Most of the calf meals on the market are suitable, also linseed mixed with flour, pollard, cod liver oil, hay tea, &c.

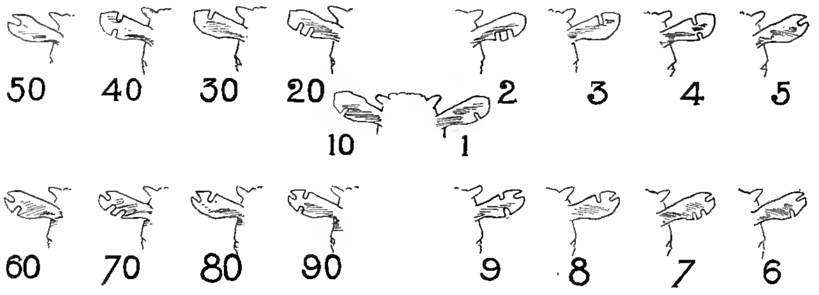
In calf-rearing a few golden rules must be observed, viz:—1st, Absolute cleanliness; 2nd, regularity of quantity and time of feeding; 3rd, temperature. For the first week the calf should be fed at least three times a day, and after that twice a day will suffice. If the utensils are not kept clean the stomach becomes deranged, and scours are produced, which, if not checked, lead to inflammation of the bowels, and death. So, also, if the quantity fed is too great the calf cannot digest it, and white scours are the result. The temperature of the cow's body in health is 101-102 deg. Fahr. That is the temperature at which calves receive the milk from the mother, and is the temperature at which all young calves should be fed. The rubber teat calf-feeders are found to give good results, particularly so with delicate calves. Great care must be exercised to keep these clean. In case of white scours, a tablespoonful of ordinary liquid rennet should be given in the milk morning and evening. A cupful of limewater should be given in the milk two or three times a week. Wherever possible calves should run on good grass, or, failing that, should have fine hay. The paddock they run in should be top-dressed with superphosphate. Calves can be well reared on whey, provided it be fed sweet, and with the addition of meal of some description. In feeding whey, oil alone is not a sufficient substitute. Linseed cake is a very suitable food for calves as soon as they can eat it.

The calf run should be dry and warm, provided with a shelter-shed with an impervious floor with good drainage, so that it can be thoroughly disinfected with crude carbolic acid in case of disease.

Milk separated at the factory or creamery, and required for feeding calves, should always be scalded, a steam pipe being fixed in a convenient place for the purpose. This makes it more wholesome. It keeps sweeter, and prevents the spread of disease such as tuberculosis.

EAR-MARKING.

The following will be found a very useful and convenient system of marking calves for future recognition. If marked as soon as dropped, and a record made in the stock-book, there will be no difficulty in tracing the calf afterwards:—



In the illustration the notches appear somewhat large, but a quarter-inch punch will not disfigure the ear.

For marking stud or show animals, tattooing a number on the inside of the ear is the best.

DEHORNING, &C.

Calves should be dehorned, except those required for show or stud purposes. The best time to dehorn is before the calf is five days old. Clip the hair from about the base of the horns, slightly moisten the end of a stick of caustic potash, and rub the tip of each horn for about a quarter of a minute. This should be done two to four times, at intervals of five minutes. If a little blood shows at the centre of the horn, very slight further rubbing will be necessary. Care should also be taken to rub the centre of the horn, and not the sides, and not to have it too moist, for if it runs on to the skin a troublesome sore will result. A piece of brown paper should be wrapped round the caustic to protect the fingers.

Bull calves should be castrated when about one month old. If much older, the animal receives more of a check by the operation.

HOOSE, OR LUNG WORM.

If calves have to run on damp ground, they should be provided with a warm dry shed, and the ground should, as soon as circumstances permit, be thoroughly drained, otherwise they may be affected with hoose, or worm in the throat. If attacked by this complaint they appear to be in bad health, exhibit a dirty, staring, harsh, dry appearance of the coat, and they have a cough, with discharge of mucus. When the mucus is examined under a microscope, embryo worms may be found in it. If a calf which has died from this complaint is opened, a ball of fine worms will often be found in the bottom of the wind-pipe.

Affected calves must be kept dry, warm, and well fed, and given half an ounce to one ounce of turpentine soaked into dry meal and then mixed with cold gruel, which may be repeated once or twice after an interval of a few days. When given in this way the risk of choking from turpentine is reduced to a minimum.

RINGWORM.

Young cattle, if in poor condition, are often troubled with ringworm. White scaly patches, without hair (most abundant about the head and neck), caused by a vegetable parasite, appear. These may be destroyed by applying red mercurial blistering ointment, made by mixing one part of biniodide of mercury with sixteen parts of lard, this being half the strength of the blister; or carbolic acid. The parts should be prepared by scraping off the scales or washing them with kerosene a few days previous to applying the dressing.

LICE.

If cattle, young or old, are allowed to become too poor, or fed for a time on insufficient nutritious food, as barley straw, they are liable to become infested with lice, mostly about the head, neck, and withers. These may be best destroyed by dressing with phenyle or other carbolic preparation. Care should be exercised when applying any wash of a poisonous nature, as serious loss sometimes results through the animal licking its skin.

BLACKLEG.

The greatest scourge of young cattle is "blackleg," or, as it is sometimes called, "symptomatic anthrax." This complaint most frequently attacks calves from about three months to two years old, generally the finest and best conditioned calves about the time of weaning. The symptoms are harsh, dry appearance of the coat, loss of appetite, sometimes stiffness in one leg, accompanied by swelling. The animal invariably dies in 24 or 48 hours. Generally there is a frothy mucous discharge from the nose, tinged with blood. If the fingers are rubbed over the skin a crepitation is apparent like the crinkling of paper, due to the formation of gas beneath the skin. If the swollen part be opened it will generally be found to consist of a yellowish, jellylike, watery tumour. Where mortality occurs from this complaint the whole of the carcasses should be completely destroyed by fire. There is no cure, and the only course open is prevention by inoculation by "blacklegine," which can be obtained from the veterinary surgeon, with instructions how to apply it. If the complaint makes its appearance, all the young cattle should be inoculated.

Scale of Points for Judging a Dairy Cow.

In the accompanying illustration are indicated the parts of the cow taken into consideration in judging her merits as a dairy animal:—

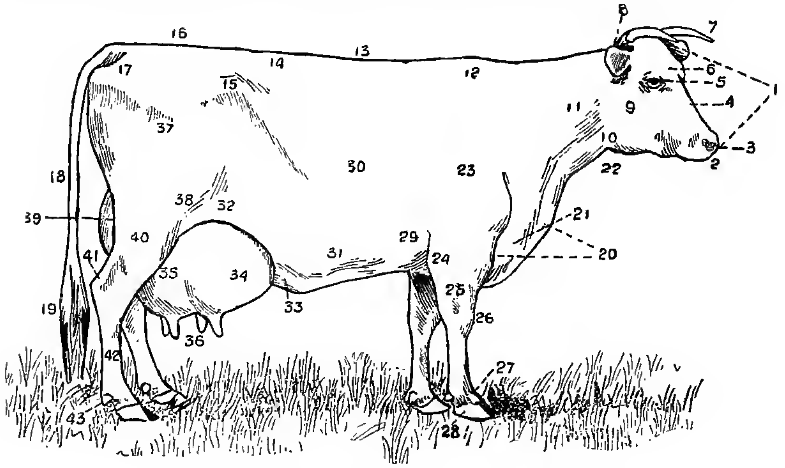


DIAGRAM OF COW, SHOWING POINTS.

1. Head.
2. Muzzle.
3. Nostril.
4. Face.
5. Eye.
6. Forehead.
7. Horn.
8. Ear.
9. Cheek.
10. Throat.
11. Neck.
12. Withers.
13. Back.
14. Loins.
15. Hip-bone.
16. Pelvic Arch.
17. Rump.
18. Tail.
19. Switch.
20. Chest.
21. Brisket.
22. Dewlap.
23. Shoulder.
24. Elbow.
25. Forearm.
26. Knee.
27. Ankle.
28. Hoof.
29. Heart girth.
30. Side or barrel.
31. Belly.
32. Flank.
33. Milk vein.
34. Fore udder.
35. Hind udder.
36. Teats.
37. Upper thigh.
38. Stifle.
39. Twist.
40. Leg or gaskin.
41. Hock.
42. Shank.
43. Dew claw.

In judging dairy stock, 100 is assumed to represent the ideal or perfect dairy cow. The following is a list of the general qualities and particular parts considered, with the figures at the right indicating the "weight" or importance attached to each in making up the total of 100 points, which stands for perfection.

GENERAL APPEARANCE.

Constitutional Vigour—As shown by size, apparent health, strength, activity and "general appearance"	5
Form—Wedge-shaped as viewed from front, side, and top ...	5
Quality—Hair fine, soft, skin medium thickness, loose, mellow, and unctuous, with yellow secretion	5
Temperament—Active and nervous (but not "wild"), indicated by movements, eyes, and lean appearance	5

HEAD AND NECK. ....

Forehead—Broad and full	2
Horns—Small and fine, not too long, set well apart	1
Eyes—Large, prominent, bright, and yet placid	1
Face—Lean, not too short, straight or slightly dished	1
Muzzle—Clean and strong, mouth and nostrils large	1
Ears—Medium size, fine in texture, yellow secretion abundant ...	1
Neck—Rather long and thin, fine; clean throat and light dewlap ...	1

FORE QUARTERS.

Chest and Brisket—Broad and strong, low, but not too fleshy ...	3
Withers—Well defined, firm, and lean	1
Shoulders—Light, not fleshy, and oblique	1
Legs—Straight, rather short, and not too large or coarse	3

BODY.

Back—Well defined, lean, open jointed, not too level, and smooth, a good spine	3
Barrel or Body—Long and large, ribs broad, well arched, open, and well defined, a large, strong body	8
Heart Girth—Large and deep, abundant room for active heart and lungs	4
Belly—Large, broad, and deep, with a large and strong navel ...	6
Loin—Broad and strong	3

HIND QUARTERS.

Hips—Wide apart	2
Pelvic Arch—Prominent and strong	3
Rump—Long and wide	2
Tail—Long, fine, with a good switch	1
Thighs—Long and lean, no beefiness, thin flanks	3
Legs—Straight, rather short, wide apart, giving open twist, and not too large or coarse	3
Fore Udder—Full, broad, and extending well forward, not fleshy ...	8
Hind Udder—Broad, full, and attached high, not fleshy	8
Teats—Of good size and form, evenly placed	5
Milk Veins—Upon the udder and in front of it, prominent, large, and tortuous, leading to large, open "milk wells."	5

NOTES.—In scoring or marking, give each part the number of points which it appears to deserve upon the scale given; use fractions of one-fourth if necessary. Thus, if forehead is broad, full, and satisfactory, mark 2; if neck is short, thick, and beefy, mark ½ or ¼, or perhaps 0; if fore udder is deficient or defective, mark 6, 4, or 2, as the case may be. A good cow closely criticised and scored should have a total of 90 points or more.

—From the Year Book of the U. S. Dept. of Agriculture.

Gestation Calendar (*Woll*).

AVERAGE GESTATION PERIOD.

Mares .. 48½ weeks (340 days, extremes 307 and 412 days).
Cows .. 40½ weeks (283 days, extremes 240 and 311 days).
Ewes .. 22 weeks (150 days, extremes 146 and 157 days).
Sows .. 16 weeks (112 days, extremes 109 and 143 days).

Time of Service.	Mares, 340 days.	Cows, 283 days.	Ewes, 150 days.	Sows, 112 days.
Jan. 1	Dec. 6	Oct. 10	May 30	April 22
6	11	15	June 4	27
11	16	20	9	May 2
16	21	25	14	7
21	26	30	19	12
26	31	Nov. 4	24	17
31	Jan. 5	9	29	22
Feb. 5	10	14	July 4	27
10	15	19	9	June 1
15	20	24	14	6
20	25	29	19	11
25	30	Dec. 4	24	16
Mar. 2	Feb. 4	9	29	21
7	9	14	Aug. 3	26
12	14	19	8	July 1
17	19	24	13	6
22	24	29	18	11
27	Mar. 1	Jan. 3	23	16
April 1	6	8	28	21
6	11	13	Sep. 2	26
11	16	18	7	31
16	21	23	12	Aug. 5
21	26	28	17	10
26	31	Feb. 2	22	15
May 1	April 5	7	27	20
6	10	12	Oct. 2	25
11	15	17	7	30
16	20	22	12	Sep. 4
21	25	27	17	9
26	30	Mar. 4	22	14
31	May 5	9	27	19
June 5	10	14	Nov. 1	24
10	15	19	6	29
15	20	24	11	Oct. 4
20	25	29	16	9
25	30	April 3	21	14
30	June 4	8	26	19
July 5	9	13	Dec. 1	24
10	14	18	6	29
15	19	23	11	Nov. 3
20	24	28	16	8
25	29	May 3	21	13
30	July 4	8	26	18
Aug. 4	9	13	31	23
9	14	18	Jan. 5	28
14	19	23	10	Dec. 3
19	24	28	15	8
24	29	June 2	20	13
29	Aug. 3	7	25	18

GESTATION CALENDAR—*continued.*

Time of Service.	Mares, 340 days.	Cows, 283 days.	Ewes, 150 days.	Sows, 112 days.
Sep. 3	Aug. 8	June 12	Jan. 30	Dec. 23
8	13	17	Feb. 4	28
13	18	22	9	Jan. 2
18	23	27	14	7
23	28	July 2	19	12
28	Sep. 2	7	24	17
Oct. 3	7	12	Mar. 1	22
8	12	17	6	27
13	17	22	11	Feb. 1
18	22	27	16	6
23	27	Aug 1	21	11
28	Oct. 2	6	26	16
Nov. 2	7	11	31	21
7	12	16	April 5	26
12	17	21	10	Mar. 3
17	22	26	15	8
22	27	31	20	13
27	Nov. 1	Sep. 5	25	18
Dec. 2	6	10	30	23
7	11	15	May 5	28
12	16	20	10	April 2
17	21	25	15	7
22	26	30	20	12
27	Dec. 1	Oct. 5	25	17
31	5	9	29	21

COMMON AILMENTS OF DAIRY CATTLE.

Signs of Ill-health.

Symptoms of unhealthiness in cattle which may be seen without handling are:—

1. An animal away by itself, if accustomed to go with others, and perhaps standing with its back arched.
2. Not stretching itself on being quietly raised when lying down.
3. Hair standing on end, or staring, having a harsh, dry, dirty, dull appearance.
4. Absence of lick marks on the skin.
5. Saliva flowing from the mouth.
6. Not feeding or chewing the cud for any length of time.
7. Thin condition of the body.
8. Blown out by gas forming through fermentation and stoppage of digestion of the food.
9. Hollow sides consequent from want of food.
10. Quick breathing or a cough.
11. Peculiarity of movement of head and limbs.

Cattle Lick.

A lick consisting of 20 lbs. salt, 20 lbs lime, 20 lbs. superphosphate, and 1½ lbs. sulphate of iron, should always be in a box protected from the weather in a convenient place, and will be the means of keeping the animals in good health, preventing cripples, &c.

Ailments and their Treatment.

ABORTION IN COWS.

This may be caused by all kinds of insanitary conditions, mechanical injuries, over-driving, innutritious and badly prepared food, ergotized grain, exposure to cold, debility, tubercular affection of different organs, hernia or rupture, sympathy with cows that have aborted near at hand, sudden changes of food from poor to rich, food grown on marshy land. By far the most troublesome is the contagious form, caused by a specific germ, and is conveyed through contact with an animal that has aborted, contact with aborted calf, eating grass or fodder contaminated with the discharge or slime from a cow that has slipped, and, above all, the use of a bull that has already served or been in contact with a cow that has aborted. Extensive investigations recently carried out by Mr. J. A. Gilruth, M.R.C.V.S., Chief Veterinarian, New Zealand, have proved the advantages of the following line of treatment.

Treatment.

1. Burn the calf and any slime or other material discharged.
2. Thoroughly dig up the ground where the calf was dropped and disinfect with a solution of crude carbolic acid or phenyle, or perchloride of mercury (1 of mercury to 1,250 of water).
3. Isolate the cow and keep her isolated for two months.
4. Thoroughly disinfect the cow by the following means:—
   - (*a*) Into an ordinary whisky bottle (1½ pint) put two tablespoonfuls of 1 per cent. solution of perchloride of mercury (or one tabloid), and fill up with rain water that has been boiled and allowed to cool to blood heat.
   - (*b*) Get a piece of half-inch rubber hose, three feet long, insert into one end a funnel of glass or enamelled metal.
   - (*c*) Boil the funnel and tube for five minutes.
   - (*d*) Place the free end of the piping by means of the hand gently into the womb, taking care not to injure the lining of the womb.
   - (*e*) Hold the end to which the funnel is attached about six inches from the root of the cow's tail.
   - (*f*) Pour the contents of the bottle, as described above, gently into the funnel, and so thoroughly irrigate the womb. If the fluid does not run freely from the tube, the end in the tube need only be gently moved to and fro to secure a free flow.
   - (*g*) Thoroughly wash down the parts from the root of the tail down to the bottom of the udder with another bottleful of the same solution as that used for irrigating the womb.
   - (*h*) Allow the animal to stand quiet in the bail for two hours after treatment.

If the bull has had contact with any cow that has slipped, he should be placed in a crush, and penis and sheath thoroughly washed with the solution. An enema is used to inject the solution into the sheath.

Limewash the buildings, adding to each bucketful of limewash half a pint of crude carbolic acid.

In many cases the disease has been checked and eradicated by giving pure carbolic acid, either as a drench or in the food daily to each cow, commencing with small doses and increasing to half an ounce every second day.

Perchloride of mercury (corrosive sublimate) may be obtained in the form of tabloids, each containing 8·75 gr. Be careful that the whole of the tabloid is thoroughly dissolved before using the solution, as any undissolved particle lodging on the lining membrane of the vagina or womb would cause intense irritation.

Where several cows in a herd abort or keep returning to the bull, it is found to be absolutely necessary, in order to prevent the spread of the trouble, and to insure its complete eradication, that not only these cows, but every cow in the herd, should be treated by the mercuric chloride solution. (The same treatment may be applied to mares.) The strength of the solution of mercuric chloride to be used as follows:—For cows which are repeatedly returning to the bull or apparently sterile, 1 in 1,250, or one tabloid in a pint and a half of water, or a tabloid dissolved in a clear-glass wine bottle of water which has been recently boiled and allowed to cool to blood heat.

For a bull a solution of the same strength should be used.

For cows which have just aborted a weaker solution (1 in 2,500) should be used, and applied once daily for three successive days, and at weekly intervals afterwards if there be any discharge from the vagina. This solution can be made by dissolving one pellet in three pints of water.

For cows more than three months pregnant which are to be treated as a preventive measure the solution 1 in 2,500 should be used. Unless in the case of an actually aborted cow, one application only is necessary if properly carried out.

In treating the bull, place him in a crush pen, then grasp the sheath by the left hand, and pass the nozzle of the syringe inside the sheath, afterwards holding it in position with the same hand. Then, with the right hand, pump into the sheath a quantity of the solution, sufficient to thoroughly irrigate the parts.

RED WATER IN CATTLE, BLACK WATER, OR ASTHENIC HAEMATURIA.

Red water is generally caused by unsuitable food, which is innutritious and indigestible, and the blood becomes impoverished; sometimes it is due to injury.

Symptoms.—There is a frequent discharge of small quantities of urine containing, as a rule, coagulated blood. Pressure on the loins may cause pain; the animal stands with its back arched, moves with a staggering gait, and may show feverish symptoms.

Treatment.—As it is the result of various causes, it may require varying treatment. It is advisable to give a laxative, as 12-16 ozs. Epsom salts, ½ lb. treacle, ½ oz. ginger, or 12-16 ozs. raw linseed oil, or 12-16 ozs. castor oil. Cold applications to the loins may be of use, and the following draught:—

Tincture of perchloride of iron, ½ fl. oz.
Spirit of chloroform, ½ fl. oz.

Mix in water and give twice daily.

If the cattle have access to the lick previously mentioned they will rarely be affected. For red water in young calves, the most successful treatment is to give, twice a day, two teaspoonfuls of mustard in one tablespoonful of lard.

MAMMITIS, INFLAMMATION OF THE UDDER, GARGET, OR MASTITIS.

Symptoms.—The udder becomes hard and inflamed, the milk curdles in the udder, and often clotted blood is mixed with it. The cause may be injury, cold, or a particular bacillus. In the latter case it is contagious, and often runs through a herd if not checked.

Treatment.—Give the salts dose. Bathe the udder well two or three times daily with warm water, not too hot, but keeping the temperature fairly even by the addition of hot water. Draw the milk away frequently, taking care to get the clots out of the teats. The udder may be rubbed well but gently with iodine ointment (one part iodine to eight of lard). Carbolic acid or boric acid should be used in the water for bathing, also the water for milkers to wash their hands in, and the floors of the sheds disinfected with phenyle or carbolic acid. This will be the means of preventing the spread of the disease. The strippings from an infected quarter should not be allowed to drop on the ground, but should be milked into a bucket containing carbolic acid, which will destroy the germs.

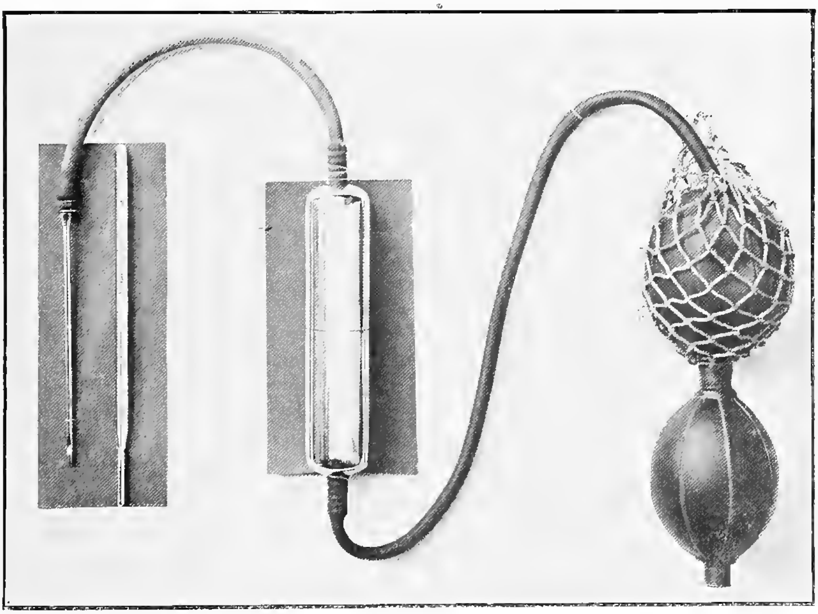
The latest approved treatment for mammitis is to inflate the udder with air in the same way as for milk fever, by means of the milking tube and enema, or bicycle pump. Inject as much air as possible, then massage or work it well in, so as to drive the air into all the minute ducts of the udder. While massaging let the air escape, and then fill up again, until you get the air all through the udder. In bad cases, only a very little may be injected to commence with, but by degrees it will be worked all through. This should be repeated every day. If the whole udder is affected a compress should be used, consisting of heavy cloth, which is tied on over the back, so that it lifts the weight of the entire udder. Straw or some soft material is used for padding over the back to prevent it chafing. This is to relieve the pressure. Five or ten pound bags filled with bran, kept hot and applied to the udder, will help to take down the inflammation.

MILK FEVER.

Milk fever generally occurs within three days after calving, although it may come on before calving, or several weeks after. A short time after delivery the cow shows signs of restlessness, raising first one hind foot and then the other, breathes a little more quickly, does not like movement, and if caused to move staggers in her gait, loses her appetite, ceases to chew the cud, and has a staring look in the eyes. The hind limbs give way about twenty hours after onset of disease, the animal falls, and remains down. The eyes now protrude, and may be insensible to the touch, there is general loss of sensation and voluntary movement The head and horns will be hot owing to the rush of blood to the head. The animal may be delirious and dash its head about, in which case it must be prevented from hurting itself, by padding with bags of straw and chaff, and kept in a sitting position. The animal may become comatose, with head bent towards the shoulder, cannot swallow, bowels do not act, urine remains in the bladder, becomes blown up with wind, more and more comatose, and at length dies.

As soon as it is seen that anything is wrong with the health of the animal, the following dose should be given :—16 ozs. of Epsom salts, ½ lb. treacle, one tablespoonful of ground ginger, in about a quart of warm water or gruel. (This should be given to any cow at any time showing signs of ill health.) The animal should be kept warm with rugs or bags, cold water may be applied to the head, the spine rubbed with a liniment composed of liniment of ammonia, one fluid part, and compound liniment of camphor, one fluid part, or a paste of mustard and turpentine. Half a pint of spirits should be given occasionally as a stimulant (say every three or four hours); methylated spirit will do for this, and is much cheaper than anything else.

The womb should be flushed with a 2 per cent. solution of Lysol by means of a piece of hose pipe passed in by hand. The temperature of a cow in health is 101-102 degrees; in case of milk fever it will be below this, and in other fevers above, and this is an infallible guide as to the nature of the disease, and will distinguish it from a form of blood poisoning, sometimes a trouble at calving. If the cow is insensible, medicine should be given by pushing a piece of hose pipe down the throat into the stomach, and the medicine poured down this direct into the stomach, otherwise it may get into the lungs and either choke the beast or cause inflammation of the lungs. This will also let the gas out of the stomach.



MILK FEVER APPARATUS AND VETERINARY THERMOMETER.

Of all the known methods of treating milk fever, the injection of sterilized air into the udder is by far the most simple and practicable, as well as the most efficacious and harmless one yet tried, and only occasionally requires the concurrent use of medicinal treatment. At the milking herd trials at the St. Louis World's Fair last year the Jersey herd competing numbered 41 cows, and 21 of these were down with milk fever. All were saved by air being pumped into the udder by a bicycle pump. No medicine was administered internally. The method of injecting the sterilized air into the udder is easy of manipulation, requires but little time, and is readily accomplished by means of a milk-fever apparatus, illustrated above. It consists of a metal cylinder, divided in the centre, one end screwing into the other; a small nozzle at each end, which is inserted into rubber tubing. The cylinder is filled with sterilized wadding . A bicycle pump or an enema is attached to one end by means of 9 inches of rubber tubing, and a milking tube to the other by the same means.

Previous to making the air injection the hands should be thoroughly cleansed, also the udder. Soap and water should be applied to the teats and udder, a clean towel spread underneath to prevent the teats coming in contact with dirt, then they should be carefully disinfected with a 2 per cent. solution of Lysol. About a wineglassful of the Lysol solution should be injected into each teat. This will sterilize the ducts of the teat and prevent the introduction of germs that will cause inflammation of the udder. The lower part of the cylinder, the tubing, and milk tube must be sterilized before using for injecting. This may be done by soaking in the Lysol solution, or by boiling for fifteen minutes and not allowing it to touch anything until inserted into the teat. It is then carefully inserted into the teat without emptying the udder of milk. The air is now pumped from the bulb or pump and a continuous flow of air is forced through the filtering chamber and into the udder. Slight rubbing or kneading will cause the innermost recesses of the milk ducts of the udder to be distended with the injected air. After the quarter is well distended and sufficiently tense, the milking tube is removed, care being taken to prevent the outflow of air by having a broad piece of tape tied round the teat when the milking tube is withdrawn. The same treatment is repeated in the other three teats until the udder is satisfactorily distended. Should the air become absorbed and no improvement is noted, the treatment should be repeated in two or three hours, taking the same antiseptic precautions as at first. The tape should be removed from the teats two or three hours after the cow gets on her feet. A cure will just as certainly be effected by simply pumping air into the udder by means of the bicycle pump or enema and milking tube. but the risk of introducing septic or blood poison germs is considerable. hence the adoption of the antiseptic precautions recommended above. Prevention is better than cure, and if the cows are given a dose of salts and kept on short feed for a week or so before calving there will not be much danger. The greatest danger is with cows that are full blooded and rapidly thriving, more so than with fat animals.

FOUL.

May be caused by horn growing irregularly and cracking and dirt getting in and local inflammation; foreign bodies sticking between the hoofs. The most usual cause is wet, the hoof becomes softened, and then irritated and inflamed by exposure to dirt, wet, and cold. Bruises or rupture of the ligaments may cause foul.

Treatment.—Great care and strict cleanliness are indispensable. With a sharp knife cut away carefully all loose horn. Place the foot in linseed poultice mixed with a mild antiseptic, such as boric acid. The foot may be bandaged after wrapping with antiseptic tow or lint with ointment of 1 boric acid to 7 of lard. If possible, the animal should be moved to dry ground. In case it has to be kept on wet ground, apply once or twice a week the following:—Melt 1 lb. Burgundy pitch with 1 lb. mutton suet over a slow fire, and add 1 lb. Barbadoes or ordinary tar, and mix thoroughly. A dose of salts will be beneficial.

Useful Recipes.

GRUEL.

1 lb. of meal to 1 gallon of cold water, set on the fire and stir until boiling; then allow to simmer over a gentle fire till water is quite thick.

BRAN MASH.

Scald a bucket and throw out the water, put in three lbs. of bran and one ounce of salt, add 2½ pints of boiling water, stir well up, cover over, allow to stand 15 to 20 minutes till well cooked.

HAY TEA (FOR CALF-FEEDING).

Hay tea is made by boiling sound hay for half an hour, the hay being best cut into half-inch chaff before boiling it. For a young calf under a month old, give two gallons of this hay tea, with four ounces of linseed and pollard, per day.

LIMEWATER.

Place a few handfuls of quicklime in a tub and fill up with water. Stir up and allow to settle; the clear water is limewater. When that is used, fill and stir up again until all the lime is absorbed, which may be seen by breathing through a tube into the lime water. If lime is present, the water will become cloudy. If all the lime has been used up, the water will remain clear, and more lime must be added to the tub.

DAIRY FARM BUILDINGS.

One of the most important points about the permanent improvements of the farm is the adoption from the commencement of a good plan for the buildings. The size and style will vary with the different branches of agriculture, but there are certain conditions that should be fulfilled in all cases. The building should be well adapted for its special purpose, it should be substantial and permanent so far as may be with due regard to its cost, and above all it should be so arranged that it can be extended so as to keep pace with the growth of the farm. Farm buildings usually consist of a collection of small erections which have been built from time to time without any general plan. As a stable or barn becomes too small for the increasing requirements of its owner, it is turned to some other use, and a new building takes its place. In this way a number of small buildings grow up, none of them perhaps as good as might have been built with the same money, and their inconvenient arrangement is a source of continual loss through the extra labour involved in carying on the routine work of the farm.

During the last few years the so-called "consolidated type" of farm building has come into favour in America. A large many-storied building is made to serve all purposes, the upper stories being used for hay and grain, the intermediate one for implements and machinery, and the lower ones for the animals. In this way four and five stories are often met with. The only disadvantage is the liability to total destruction in case of fire, while in all directions the advantages are manifest. A large building costs less, both to build and maintain, than a number of small ones which provide the same amount of accommodation, while the saving in labour goes far towards providing interest and sinking fund on the capital cost of construction. The advantages are very evident in the winter, when all the work may be done with a minimum amount of exposure to the weather

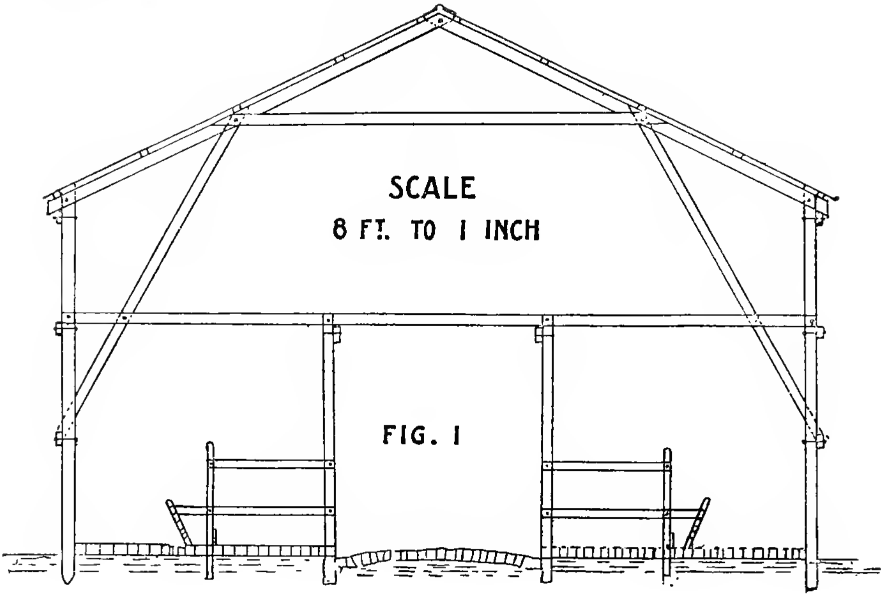


FIG. 1

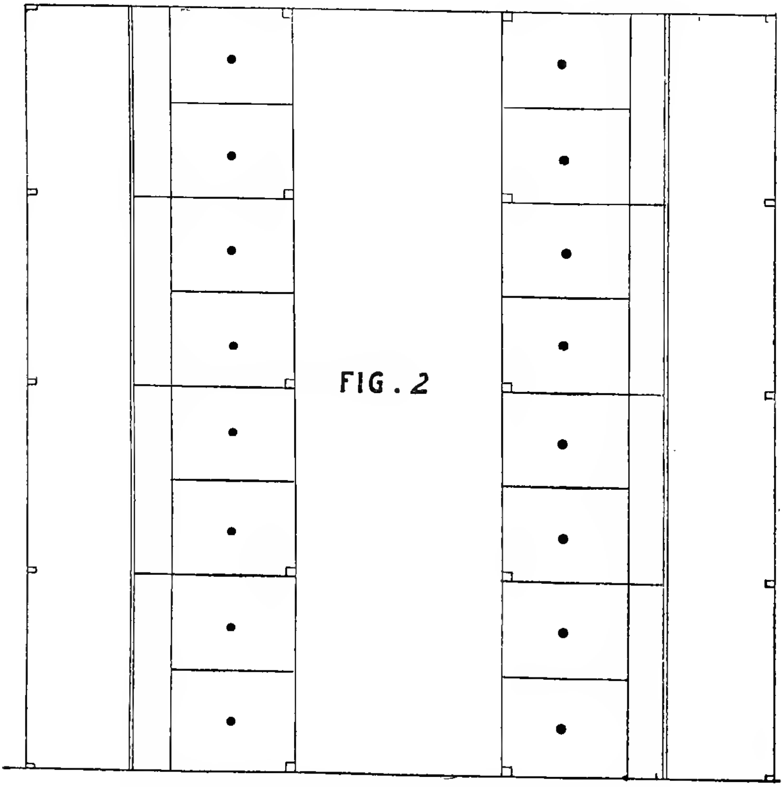


FIG. 2

TRANSVERSE SECTION AND PLAN OF BUILDING.

The present building is designed to meet the special requirements of the dairy farmer. It comprises a cow stable on the ground floor, and a large loft above which will answer all the purposes of an ordinary barn. As will be seen from Figs. 1 and 2, the building is 32 feet wide, a roadway 10 feet wide runs down the centre, the cows standing with their heads towards the walls. The framing is erected in sections of 8 feet each, an arrangement which enables the building to be gradually extended to any desired length. In order to secure this, the ordinary 4 x 2 framing is replaced by much heavier timbers, but the number of pieces of timber is much reduced, so that, on the whole, there is considerable saving in material.

The longitudinal timbers are all 16 feet long, so that by "breaking joints" alternately on each transverse principal the necessary strength is secured, whatever may be the length of the building. The building may be used either for feeding and shelter, or for milking in addition, according to the taste of the owner. The chief objection urged against milking in a building with a loft overhead, is that dust from the hay will fall into the pail. While this may be true if there is a faulty floor, it must not be forgotten that by far the greatest source of contamination of the milk is the dirt from the udders and hind quarters of the cows, and from the hands of the milkers. If the building is properly constructed, the cows groomed and scrupulous cleanliness observed, the number of stories above the cows is a matter of little consequence. Odours from the cows and bedding can be avoided by good ventilation and cleanliness. These matters are emphasized because the main point is to keep the attention directed to the principal evil. It is the little particles of cow dung which find their way into the milk which do more harm than all else combined. There is only one way of keeping these out of the pail, and that is care and attention on the part of the farmer. A good building for the milking shed is desirable, because the means necessary for securing this cleanliness are then more readily provided. But the most perfect shed will fail to secure clean milk if the owner is ignorant or careless.

Location and General Arrangement.

Besides convenience of access from the different paddocks and from the road, the farm buildings should be located at a lower level than the dwelling house, and if possible, in such a position that the prevailing winds blow from the house to the stable rather than *vice versa.* The distance should be from 50 to 100 yards, and some of the original trees should be retained or others be planted, so as to make a break between the two. The trees not only afford a grateful shade in the summer, but they protect the home to a great extent from the flies and dust. When all the native trees have been destroyed and it is decided to make a plantation, the sugar gum and wattle are the best temporary trees, while the permanent ones may be selected from the blackwood, English oak and elm, *Pinus insignis* and *Cupressus Lambertiana*, according to the locality. In wet districts a slab footpath, 4 feet wide, from the house to the milking shed will materially reduce the labour of keeping the home clean and tidy. The direction of the long axis of the building is not a matter of great importance, and if a better level can be obtained by departing from the cardinal points of the compass, there is no reason why this should not be done. In fact, a building facing the N.E. and S.W. is, in many localities, the best.

As has been already mentioned, our plan is to begin the building by erecting one end in its permanent position and arrange so as to extend it as far as necessary in the opposite direction in sections of 8, 16, or 24 feet.

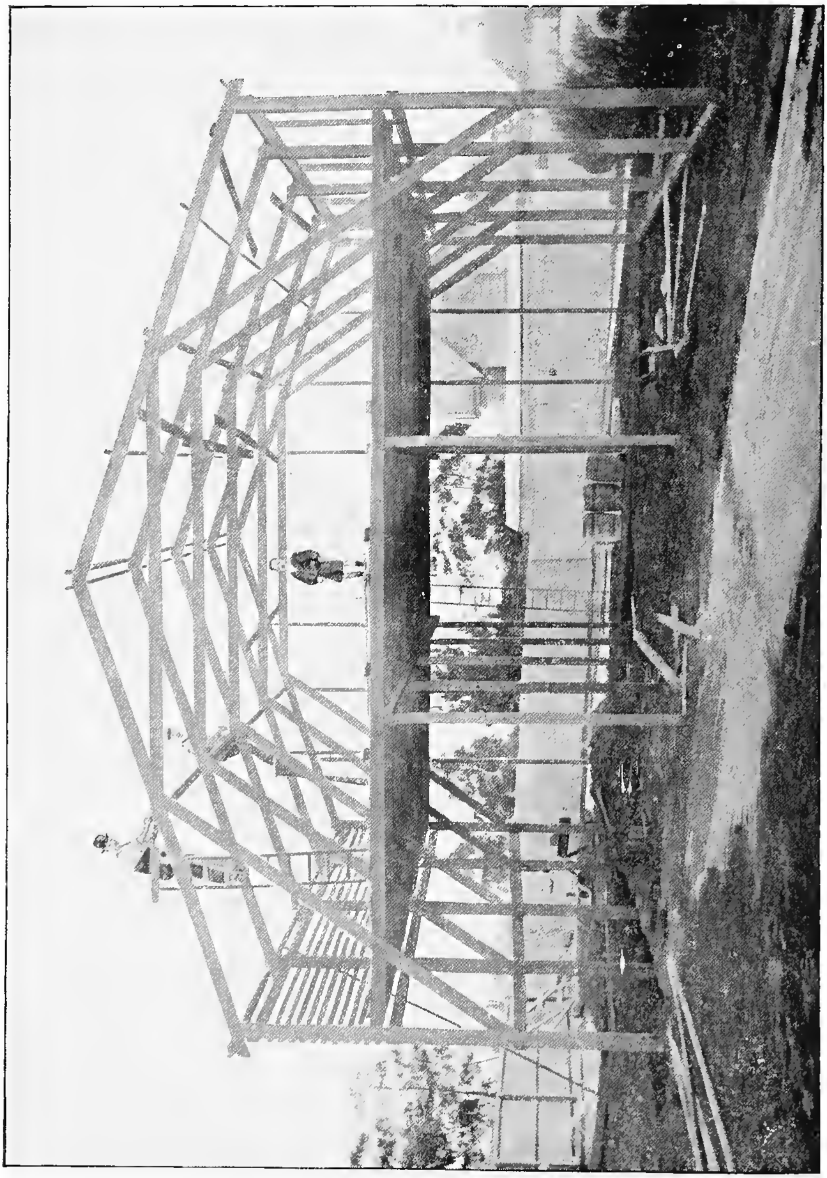


FIG 3.—FRAME IN COURSE OF ERECTION.

If means can be secured for driving the hay waggon up to nearly the level of the floor of the loft, a great deal of labour will be saved in handling both the harvest and the silage, as the chaff-cutter may be placed on this floor, and all the feeding arrangements thus be reduced to the simplest possible condition. Should the building be placed on the side of a hill a bank of earth may be formed either at the end or against the side near the end of the building. In order to protect the wall from damp, the excavation or earthwork should be kept back from the wall for a space of two or three feet, and the earth prevented from falling in by slabs or saplings, so as to allow the waggon to be backed hard up against the wall of the building.

The temporary end may be filled in with panels of either weather-boards or paling of about the same length and height as the panels of an ordinary paling fence. The rails are bolted to the studs and posts, so that the same panels may be used again whenever the building is extended. A doorway at one or both ends is provided according to the size and location of the building and its relation to its surroundings.

Details of Construction.

As will be seen from the illustrations, the framing is of the simplest description. The studs are 6 x 4, and all the rest of the framing 6 x 2, or, if more convenient, saplings may be employed throughout. Half-inch bolts are used to bolt the various timbers together. No mortices or tenons are used, and the labour involved is thus reduced to a minimum. The principals are set up 8 feet apart, this distance being selected because it allows two cows to stand together side by side. Three longitudinal plates, also 6 x 2, are bolted to the studs, one 6 feet from the ground floor, the second at 9 feet to carry the ends of the floor joists, and the third just below the ends of the rafters. The following will be found the easiest way to begin the work:—First set out the framing by laying the timbers of one of the principals on a level piece of ground in their relative positions, and bore the holes for the bolts. The distance between the two end bolts in the rafters is 17 ft. 3 in. The first set will then serve as a pattern for all the others. Then set up the studs and posts, brace them plumb, and bolt on the lower longitudinal plates and the floor joists. Then secure the brace on each side in its position by bolting it to the stud and floor joist. The rafters are lifted into position in the following way:—Bolt the outer end of the right hand rafter in its place, allowing its central end to rest on the ground near the middle of the building. Then take the left hand rafter, bolt its central end to that of its fellow, and using the left rafter as a pole, raise the right hand one to its permanent position, and fix it by the bolt at the top of the brace. The left rafter will then hang from its central bolt, its outer end is then carried up to its position and bolted to the top of the stud. The collar tie is then placed in position, and lastly, the top longitudinal plate bolted on.

The roof is best covered with galvanized iron, two nine-feet sheets being required for the building as shown in the illustrations. The battens or purlins should be 3 x 3 hardwood bolted to the rafters. Five are required for each side if nine feet iron is used. They are 16 feet long, the joists being broken on each alternate rafter.

The walls are covered with weatherboards, short 3 x 2 studs being fixed between the main ones. The space between the lowest plate and the floor of the loft is arranged to meet all the necessary requirements for ventilation. This space on the side that faces the east in a well-sheltered situation may be left open, as is the case on the side of the building away from the observer in Fig. 4; or it may be covered in as seen on the side next the observer in Fig. 4. Panels 8 feet long are hinged at the bottom so that in hot weather the whole of both sides may be left

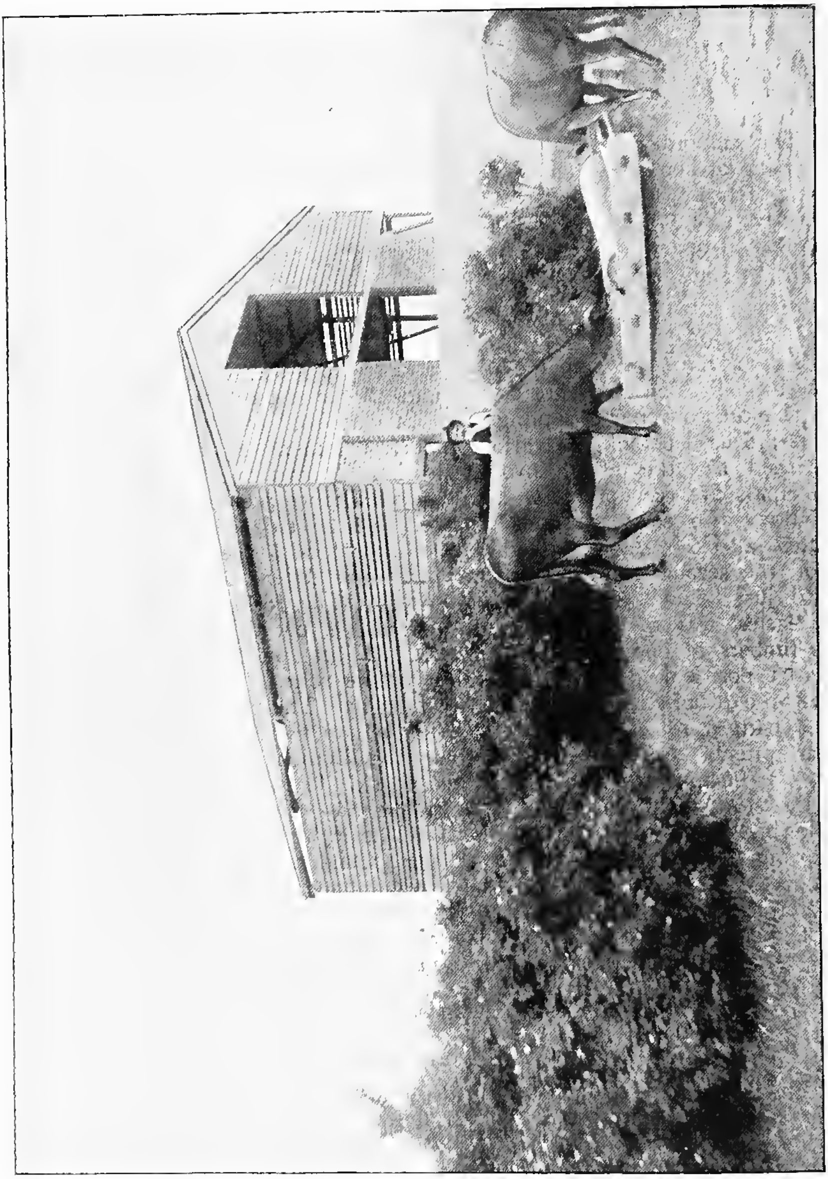


FIG. 4.—GENERAL VIEW OF BUILDING.

open. Ventilation in winter is provided by the spaces between the battens in the upper part of the panel, thus securing cross currents of air immediately under the floor of the loft.

The flooring joists are placed 2 feet apart, the ends being carried on a bearer bolted to the top of the central rows of posts. For the floor of the loft the best material is grooved and tongued softwood, but in many localities hardwood will be used, as it is much cheaper. The main objection is the shrinkage. When the green boards are first laid, this may be met by stretching a roll of building paper over the joists and nailing the flooring on top of it.* When the boards have become seasoned they may be taken up and the joints closed up. A shoot is provided in the corner at each side to allow the feed stuff to be sent down into the truck below.

As will be seen from Fig. 1, the ground floor is paved on two levels, the roadway down the middle being about 9 inches lower than the floor on each side. The part of the floor on which the cows stand runs back nearly level to the edge of the curb, where there is a single square step the full depth. This arrangement is preferable to the sloping sides of a gutter. In the latter case the animals slip about and are afraid to stand at their ease, because they know that the foothold is insecure. When on a raised level platform, however, although their feet are close to the edge, they soon get to know that there is no danger of slipping, and act accordingly. The step up is made high, so as to allow the manure to drop clear of the animals. The roadway along the middle of the building has a low crown to its centre, and the gutter is formed by this slight curve meeting the kerb. As the cost of this floor is one of the main items in the total outlay involved in the construction of the building, it is important to use the resources of different localities to best advantage. Where bluestone, granite, or other hard rock is procurable, it is best pitched throughout and grouted in cement. Where pitchers are not available, make a kerb of 9 x 3 red gum, and floor the platform and roadway for a yard on each side of the kerb with cement concrete. Many of the harder slates and sandstones found throughout central Victoria are suitable for this purpose, and quartz gravel makes excellent concrete. The remainder of the floor may be wood paved. Finally, in parts of Gippsland and the northern plains, where stone of all kinds is out of the question, a wood floor set in tar asphalt is the best available. The object is not only to keep the cows dry, but also to keep them clean, and reduce the labour of removing the manure to a minimum.

The inside fittings may be modified to suit the ideas of the individual, one arrangement being shown in Figs. 1 and 2. The posts supporting the floor joists on each side of the roadway are used to carry one end of the division between the stalls. The mangers are 5 feet 6 inches from the kerb, and between the manger and the outside wall of the building there is a 4 feet race for feeding. A truck may be run along this, and the food passed down from the loft by means of a shoot in one corner. The mangers are simply made by means of an angle rail laid along the floor to form each corner; the front and back are formed of 6 x 1 flooring, with a 4 x 2 to form the edge. The front of the manger is thus 10 inches and the back 18 inches from the floor. The lower rail between the cows may be carried forward to help in fixing the back of the manger, and at the same time it will keep neighbouring cows from interfering with one another when feeding. Two cows thus stand side by side in each eight feet space. They are best tied up by chains, the eye of which slides up and down a 16 inch bolt fixed on the posts at the mangers. Bails may be easily fixed if they are required. No divisions are placed in the mangers to separate one cow from the other, except the end of the rail already noted. In this way the whole length of the manger may be cleaned out after each feeding. A 5in. x 5in. post erected in the centre of each double stall will prevent the cows interfering with each other when lying down.

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*There are several brands of building paper, P & B, &c., procurable in Melbourne.

The advantages of this system are as follow:—

1. Uncovered cow yards are done away with. The whole herd is under shelter, and the milking is done with as much comfort as is possible.

2. The cows may be regularly fed to supplement the forage obtained in the paddock. This means a notable increase in the returns from each animal.

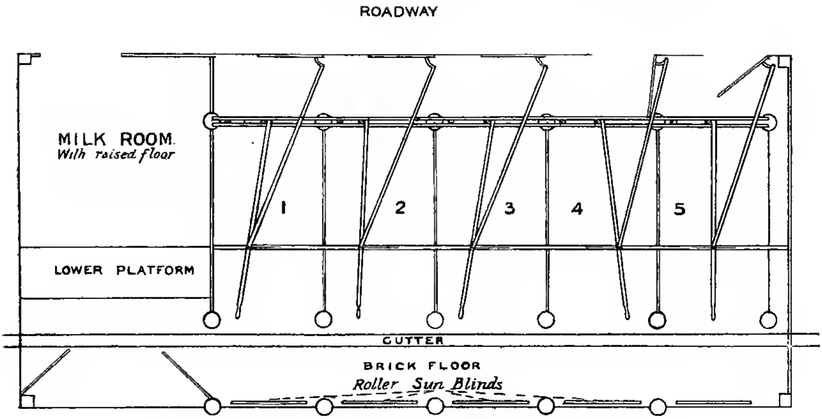
3. The cows are kept warm in winter nights. Straw or bracken fern may be used for bedding. In bracken districts this is the only way in which a pest can be turned into a valuable commodity.

4. The manure is easily secured. Each day a shovelful of dry earth is scattered at the rear of each cow. Next morning, after milking, a dray is taken through the shed, the manure removed, and carted out into a small adjoining paddock at once. It is ploughed under in the course of each fortnight. In this way a succession of fodder crops may be grown, and it will be found that the increased returns from the cows represent from five to eight shillings per load from this manure.

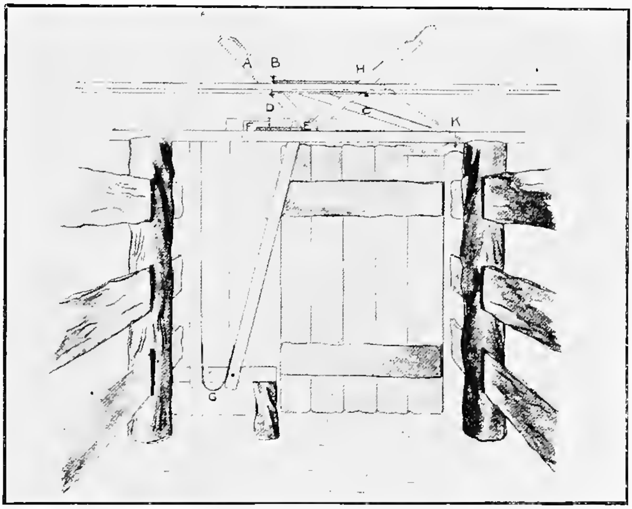
5. By the method described above, the building can be gradually extended to any length. The difficulty of breaking joints on alternate principals is met in the case of the purlins, by allowing half of their number to project eight feet beyond the end of the building until the extension is made. In the case of the side wall plates, an eight feet length is bolted between the last two principals on each side. When the extension is begun, this may be taken off and the 16 feet length substituted for it.

Other plans are given, which may be adopted if preferred, as they will be found convenient in every way. In constructing the floors of sheds in hilly districts, care should be taken not to build them up on piles, as is often done. It is very difficult to keep such floors sanitary through drainage getting underneath. They should be made solid underneath before laying the floor.

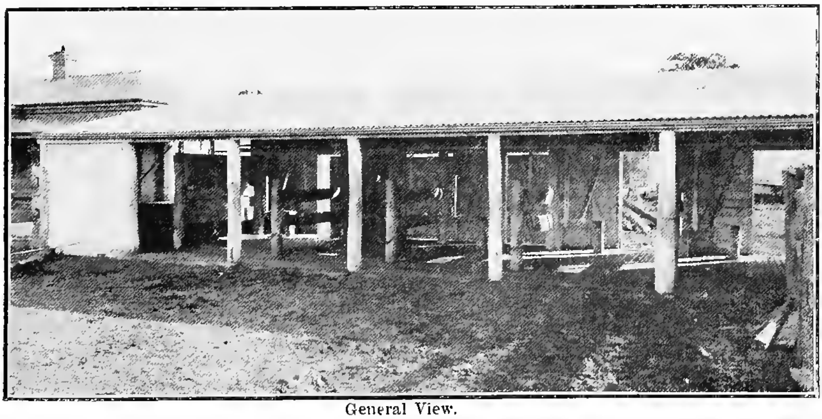
Mr. Johnson's shed (Heyfield) is the most convenient for milking alone. The cows, after being milked, walk through a door beside the bail out into the paddock, instead of returning to the yard. In the ground plan are shown "roller sun blinds," and these are found to be a great convenience. The shed has the advantage of facing the sun, which has such a purifying and sweetening effect, and when the cow is bailed up the blind behind is drawn down to shade the milker. This is far preferable to the bags generally used for this purpose. Here, too, is the best arrangement for working the bail and door from behind. In the diagram D is a stop of 3 x 1, AE the lever to close the bail. When closed the end of lever E is dropped into F, which holds the bail closed. To free the cow, the end



Ground plan of milking shed.



Arrangement for working the bail and door.



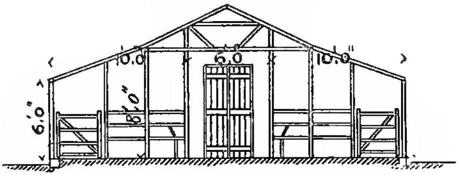
General View.

MR. JOHNSON'S MILKING SHED, HEYFIELD.

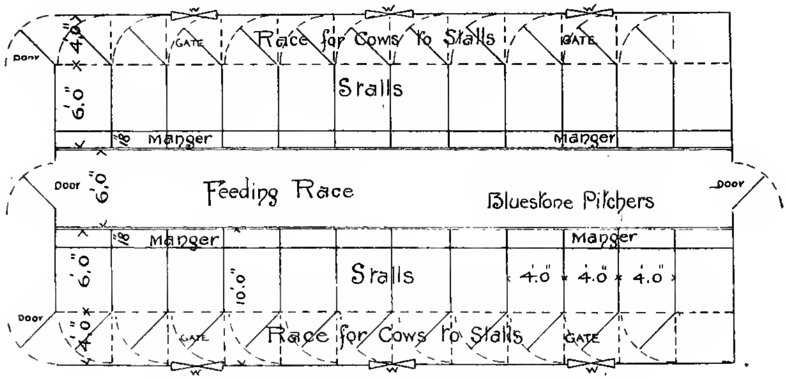
of lever is returned to E, a piece of band steel G forces the bail open. B H is another stop, and to open the door the lever A is pushed over to H, the side lever C attached to an angle K opens the door. A bolt passes through the two levers at B and through the cross piece, in which a groove is cut to allow the bolt to slide along with the lever. A study of the ground plan will make the action clear.

Instructions for Making Concrete.

Ingredients used—Cement, either broken stone or gravel, brick, shingle, &c.; the proportions should be 1 part cement to 5 or 6 parts of other material. Only good cement should be used, and if it has been exposed to the air for some time so much the better. The materials are mixed on a wooden boarding or floor. The brick, stones, or whatever is used should not exceed ½in. cube, with a considerable proportion of smaller material. Anything of the nature of clay, fine sand, loam, mud, dirt, &c., must be carefully excluded. Clean coarse sand may be used, but not in too large proportions. The whole must be well rammed, or rolled, and it will then set firmly; 3in. of concrete gives a good foundation. In cow sheds no further finishing is required, the surface being sufficiently rough to prevent the cattle from slipping. With dairies or separator rooms where a smooth surface is required, it may be finished off with cement ½in. thick, two parts of coarse sand (washed) to one part of cement. A bag or box of coarse sand should always be kept on hand, and if the floors become at all slippery a handful dusted over will counteract this.



Section

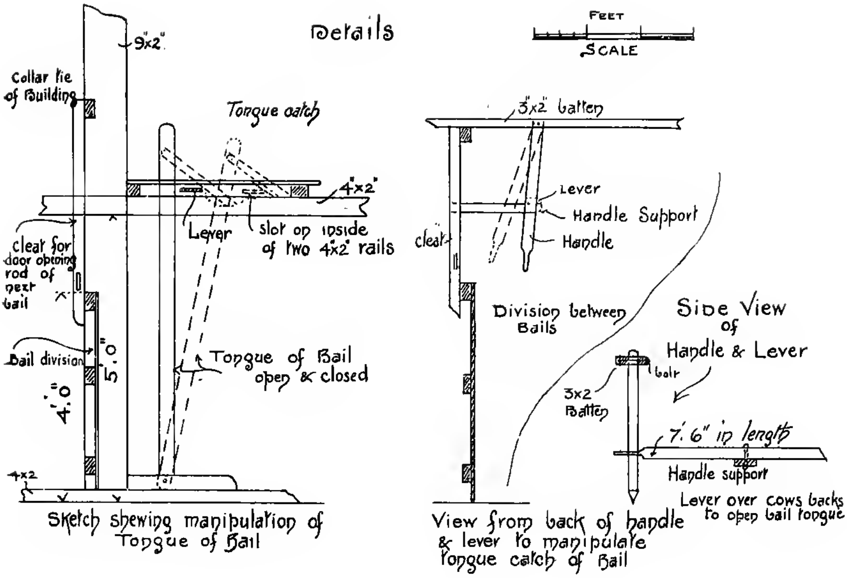


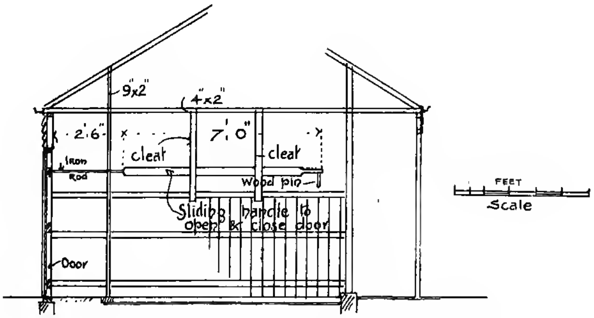
Ground Plan Feeding & Shelter Shed

FEET

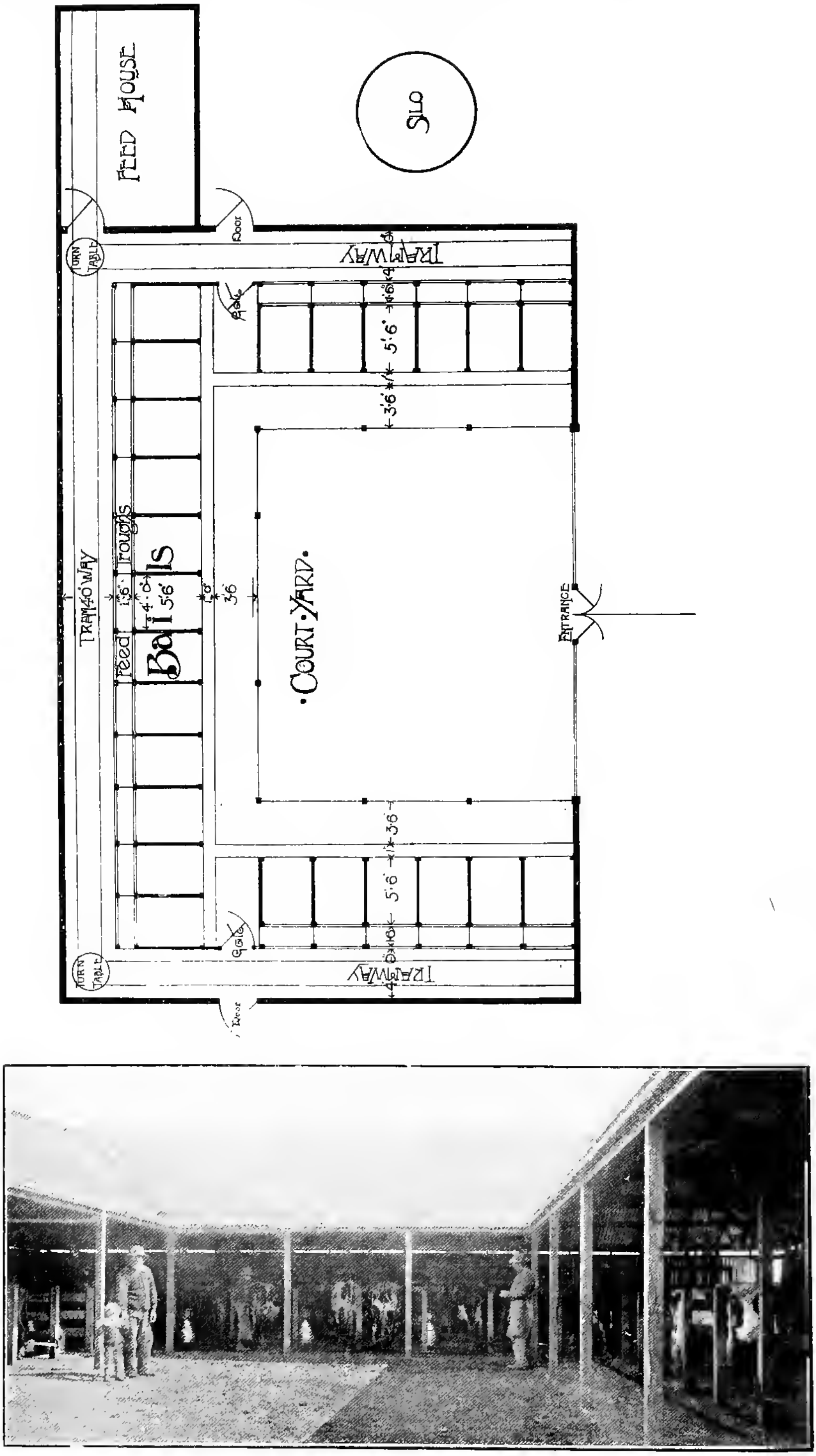
SCALE

PLAN OF FEEDING SHED AT MR. JACKMAN'S, WARRNAMEOOL.

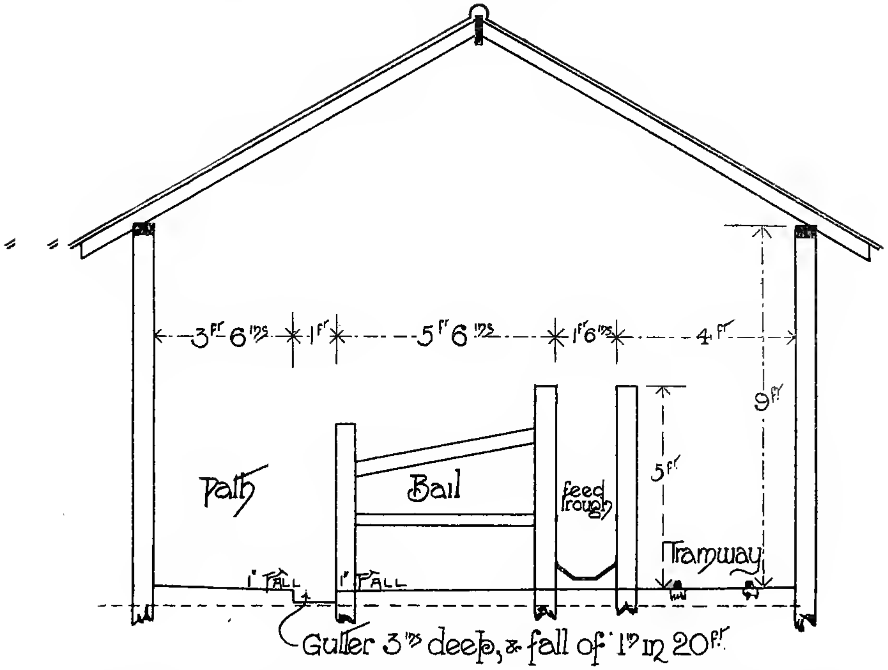

Details
Feet
Scale
9"x2"
Collar tie of Building
Tongue catch
4"x2"
Lever
slot on inside of two 4"x2" rails
clear for door opening rod of next bail
Bail division
5'.0"
4'.0"
Tongue of Bail open & closed
4x2
Sketch shewing manipulation of Tongue of Bail
3"x2" batten
Lever
Handle Support
Handle
clear
Division between Bails
Side View of Handle & Lever
bolt
3x2 Batten
7'.6" in length
Handle support
Lever over cows backs to open bail tongue
View from back of handle & lever to manipulate tongue catch of Bail


9"x2"
4"x2"
2'.6"
7'.0"
clear
clear
Iron Rod
Wood pin
Sliding handle to open & close door
Door
Feet
Scale
Sketch shewing method for opening & closing door at head of bails

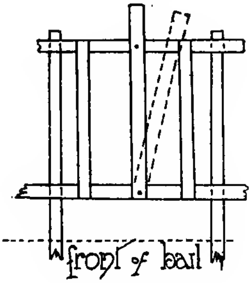
DETAILS OF MR. JACKMAN'S MILKING SHED.

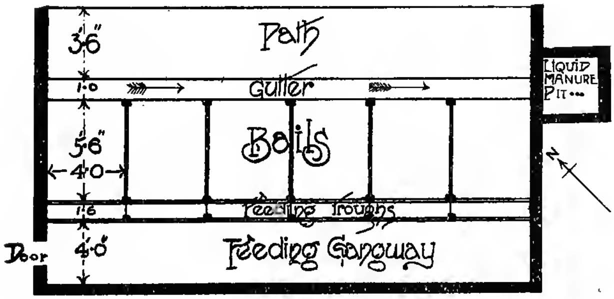


GROUND PLAN AND GENERAL VIEW OF MILKING AND FEEDING SHED, MESSRS. CAMERON BROS., YANNATHAN.



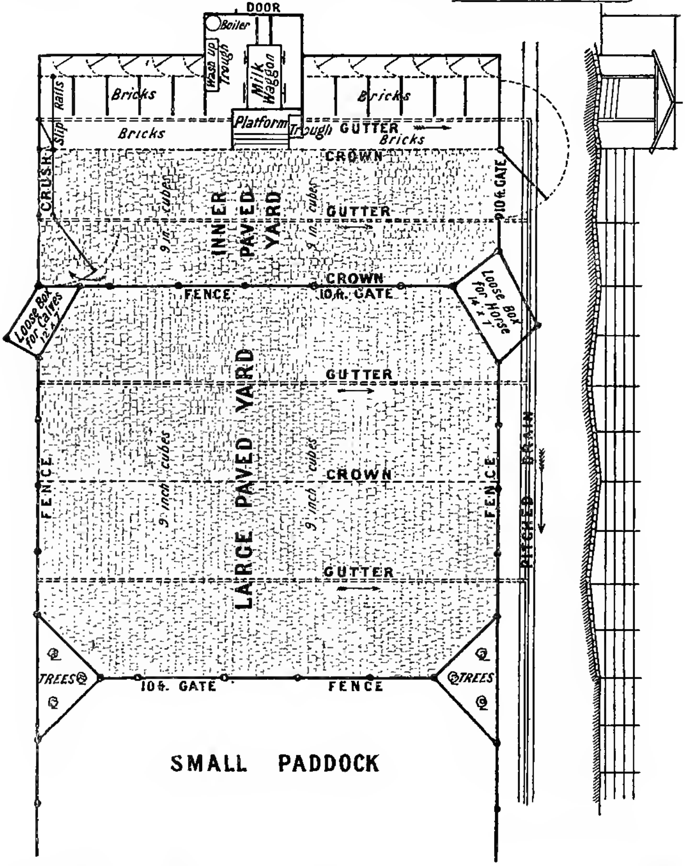
SECTION OF MILKING AND FEEDING SHED, MESSRS. CAMERON BROS., YANNATHAN.

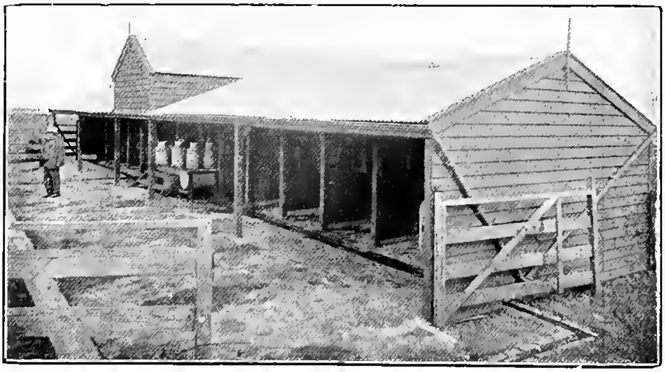




GROUND PLAN OF SMALL MILKING AND FEEDING SHED.

—Plan of—
MR G. ARMSTRONG'S MILKING SHED AND YARD, Ondit Ridge.





VIEW OF MILKING SHED.

SOME POINTS IN GROWING FODDER.

In Chapter XIII. we point out the value of the nitrogenous or proteid constituents of the food. The ease with which the requisite amount of protein can be raised is the true measure of the fertility of the farm. Plants obtain all their carbonaceous constituents, such as sugar and starch, oils, and fats, from the carbonic acid gas of the atmosphere. But for the elaboration of protein the materials must be drawn from the soil. These materials are nitric acid, ammonia, phosphates, and sulphates. They form the most valuable constituents of manure, whether artificial or collected on the farm. These are the portions of the fertility of the soil which are sold with the crop. When all the crops raised on a farm are fed to animals, comparatively little of the fertility of the land is lost. It is estimated that one-fourth of the value of a crop of wheat and one-third of the value of a crop of oaten hay are drawn from the land. In selling such crops the capital value of the land steadily diminishes. On the other hand, when the produce of the farm is sold in the form of cream the case is entirely different. The butter fat is produced by the cow from materials derived by the plants from the atmosphere, and the portion of the milk drawn from the soil remains in the skim milk. The secretion of milk by the udder is not in any sense a process of filtration. Every particle of milk is elaborated by the living cells of the animal, which are rapidly worn out in the process. These cells can only be renewed by the protein elements of the food, and hence the importance of this class of the chemical constituents of the food.

In the cow, as in all other warm-blooded animals, most of the food is used up in maintaining the warmth of the body. It is estimated that 75 per cent. of the heat producing value of the food is annually consumed in this way. In the cold weather the proportion is much greater. The maintenance of life being the prime end to which the food is devoted, it follows that the cow must be receiving a full ration, or else there will be very little left for her to turn into milk. This fact can hardly be emphasized too strongly. It follows that in the winter the milk yield can be increased by two methods—either by increasing the food or by keeping the animal warm. Every one must have observed how the cows select a sheltered corner of the paddock for a camping ground. If they have the opportunity they prefer dry ploughed ground, sheltered from the wind or frost. The records of every butter factory demonstrate that adverse weather is the chief factor in accounting for the falling off in the milk yield. The milk supplied is not only deficient in quantity, but very poor in quality. The cow has been burning up the sugar and fat in her own body in order to keep herself warm.

Of the various methods of providing shelter for the herd, none can compare with housing them in a warm, well-ventilated stable. A large shovelful of dry earth daily will make the floor much warmer, and absorb the liquid portion of the manure. Of bedding materials, young bracken forms one of the warmest, and, from the chemical point of view, one of the richest of available materials. On most farms bracken grows only too readily, and its use for bedding will benefit the farm in more ways than one. Barnyard manure, consisting of the excrements of the cow mixed with bracken, and the above proportion of earth, has the following average chemical composition, the most valuable part being derived from the urine:—

Composition of Barnyard Manure.

Moisture	73·0	to	77·5	per cent.
Nitrogen	·78	,,	·34	,,
Phosphoric Acid	·40	,,	·16	,,
Potash	·84	,,	·40	,,

Calculated at the current market rates for nitrates, potash, and phosphates, its value varies from 7s. 6d. to 10s. per ton. It is estimated that each cow will produce a ton of this manure a month if bedded every night and housed during the greater part of the day when the weather is bleak and wet. When thus furnished with a large quantity of valuable manure, the farmer has the means at hand for growing all the food stuff necessary to keep up the full yield of milk all the year round. Of still greater importance is the fact that he can raise heavy crops of roots, maize, and green fodder, and thus make the rations of the cow appetizing and digestible, enabling her to secure the full value of the dry portion of her food. We have already pointed out that the rich young herbage of the spring is the ideal food for the milch cow. The more nearly we can imitate this the better the results will be. The importance, therefore, of succulent food is readily explained.

In order to secure the full value of the barnyard manure, a small area of land, say an acre for every four cows, should be kept constantly cultivated. As fast as the crops are taken off one strip of it, this should be at once manured at the rate of ten to fifteen loads to the acre, and a fresh crop put in. The chief source of losses in farmyard manure is exposure to the weather. Fermentation takes place, the ammonia evaporates into the atmosphere, the nitrates and phosphates are washed away by the rain. When once the manure is buried in the field its fertilizing constituents have been secured. Another important point about farmyard manure is that it improves the mechanical condition of the soil. Light soils are compacted and rendered more retentive of moisture; heavy soils are loosened and aerated. By this means land of almost any description can be made capable of bearing a succession of heavy crops. The more it is cultivated the richer it becomes. The crops which are to be grown for the cows vary in different districts. The requirements of the herd should be considered six months in advance, and a rotation of crops sown in their proper season. In nearly every part of this State oats or barley with tares may be sown in the autumn, followed by peas and beans, and these by mangels. In the spring maize, sorghum, and amber cane have proved the most valuable in the Victorian experimental fields 1903. If with these is conjoined an area of oaten hay capable of yielding half-a-ton for each cow, and a quarter of an acre of lucerne, ample provision has been made for supplementing the natural pasture grass. (See chapter III.)

The only point which remains to be considered is the difficulty of providing water for the growing crops in summer. On many farms considerable areas may be watered by gravitation or by pumping from a creek if the site of the cultivation paddock is chosen with this purpose in view. The equivalent of three and a half inches of rain per acre may be provided (after allowing an ample margin for evaporation) by a dam containing 600 cubic yards of water. The advantage of being able to keep maize and lucerne growing at the period when their growth is most rapid is very great. Every farmer should aim at making the necessary provision, and the work may well be done in sections, the capacity of the dams being increased from year to year. The surplus grasses of the spring may be turned into ensilage instead of being allowed to go to waste, and a crop of maize, plainted in September or October, will in most years arrive at the necessary point of maturity without irrigation. The surprising results attained by private irrigationists in several districts are described in chapters III. and V.

Ensilage.

Three methods are adopted of making ensilage, the stack, the pit, and the over-ground silo. Whenever a green crop is thrown together in a heap, fermentation takes place. The aim of a successful system of ensilage is to control this fermentation and reduce it to a minimum. Fermentation is a process of combustion. Whenever a log of wood is burnt, or the body heat of an animal is maintained, or fermentation is set up, the heat is produced by the union of the carbon of the organic matter with the oxygen of the air resulting in the formation of carbonic acid gas. In the case of ensilage the portion of the material which is thus lost is not the fibrous and woody parts of the plant, but the starches and sugars which form the most valuable food constituents of the crop. In stack and pit ensilage, the loss amounts in most cases to from 15 to 25 per cent. of the nutritive materials of the whole. It will thus be seen that the saving of the sugars and starches is the chief point to be attained. The over-ground wooden silo, when properly constructed, reduces this loss to from 5 to 10 per cent. From experience extending over many years, the Americans have settled three points—

(*a*) That ensilage crops should be passed through the chaffcutter before packing in the silo.
(*b*) That the silo should be at least 25 feet high.
(*c*) That maize is the most profitable crop to grow for ensilage. It gives by far the heaviest yield per acre, and, when cut at the right time and chaffed, no air is retained in the mass. The exclusion of the air is the main factor in preventing fermentation.

It will be seen that the collection and careful use of the manure of the dairy herd is the key of the whole position. The falling off in milk can be obviated by conserving the warmth of the cow and feeding her up to spring level. The housing during the winter nights is the best protection against the cold, and thus economises food, while at the same time it furnishes the means for growing all the necessary crops. It is of no use to attempt to cultivate a large part of the farm. A small area should be kept in a high state of cultivation, and the chief efforts concentrated upon it alone. A farm of 100 acres, under existing methods, carries on an average less than twenty cows. If five acres of land be taken in hand as indicated, and a succession of two crops grown each year, the total amount of ploughing works out at fifteen acres, representing, perhaps, one day's work in a fortnight. The two crops off the five acres should yield at least 200 tons of green fodder in the course of the twelve months, or about 65 lbs. per head every day of the year.

The time occupied in cleaning out the stable every morning is not greater than that which is at present wasted in hunting for the cows among the stumps and logs before daylight. The monetary returns of the new method will be at least double what the same farm now produces. Excellent examples of this method of dairy farming are to be found in the present chapter and in Chapter III.

DAIRY MANAGEMENT.

The quality of the butter made in this State largely depends on the care bestowed on the production and treatment of the milk and cream before being manufactured. In the interests of the dairying industry it is necessary for the producers to exercise every precaution to insure the production of a first-class quality of butter. This fact is recognised by most dairymen, but there are some who do not give due attention to these matters.

It is to be regretted that it is not possible to deliver all the milk produced to the creameries and factories, and it is deplorable to find many who are within easy reach of a creamery or factory trying to separate the milk from their own cows and manufacture their butter in small lots.

Perhaps the worst results are obtained from cream separated on the farms and kept until too old before being delivered to the place of manufacture. The cause for complaint is not due to the use of small separators, but to the want of proper conveniences and accommodation, and, the lots being small, the necessary care is not given to the cream.

In our warm climate it is absolutely essential to have the aid of refrigeration at all times of the year in order to make best butter.

In the absence of refrigeration the quality of the output is irregular, so, in order to attain and keep up uniformity, the milk should be delivered to where it can be treated in large quantities and manipulated to best advantage.

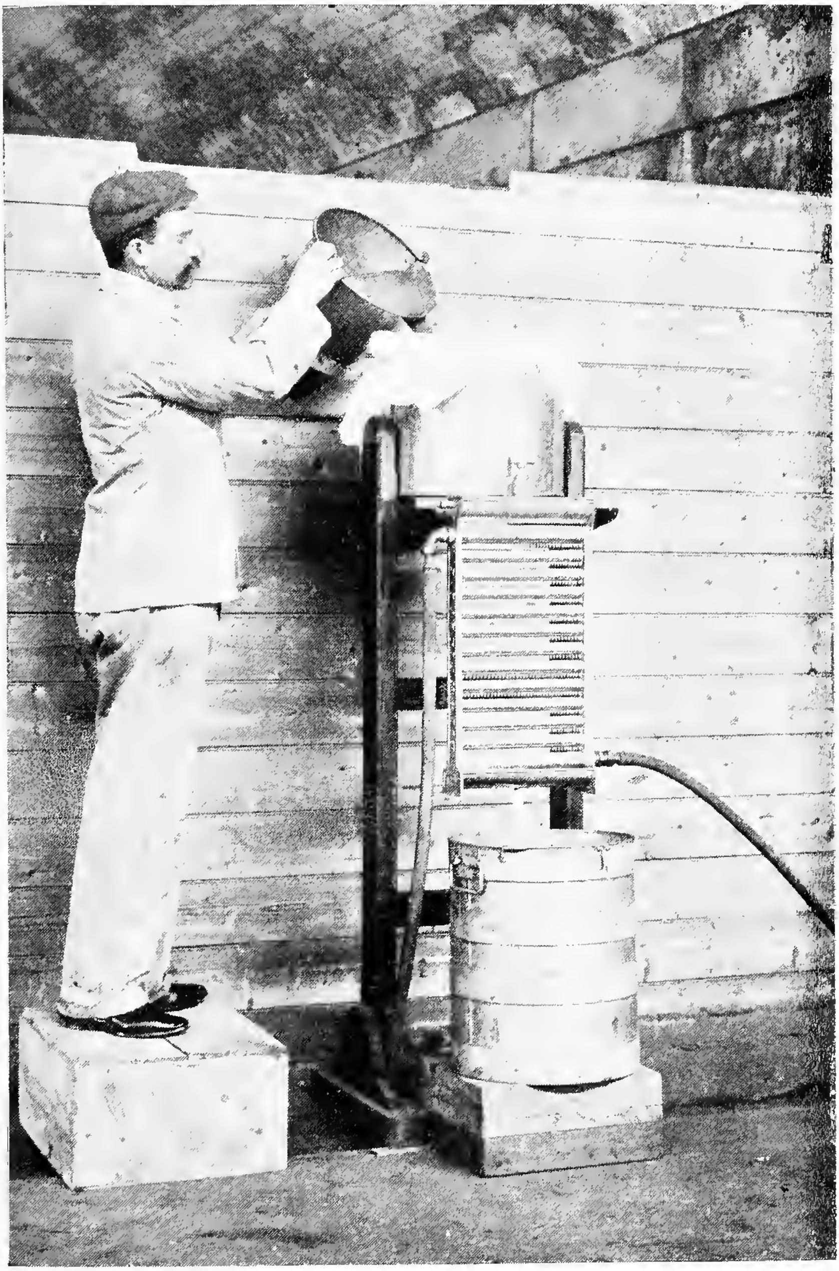
With a view to encouraging an improvement on the existing conditions, the following rules have been suggested by the dairy experts connected with this Department as a guide to dairymen:—

The Care of Milk.

Milk should be drawn from the cows in as cleanly a manner as possible. The surroundings should also receive due attention. It is a pleasure to notice the recent rapid increase of modern well-drained and paved milking-yards; together with well-arranged and ventilated milking-sheds. Examples can be met with in every district that serve as models for the neighbours to copy. When yards are convenient in their arrangement and paved, it is easy and pleasant to work in and keep them clean.

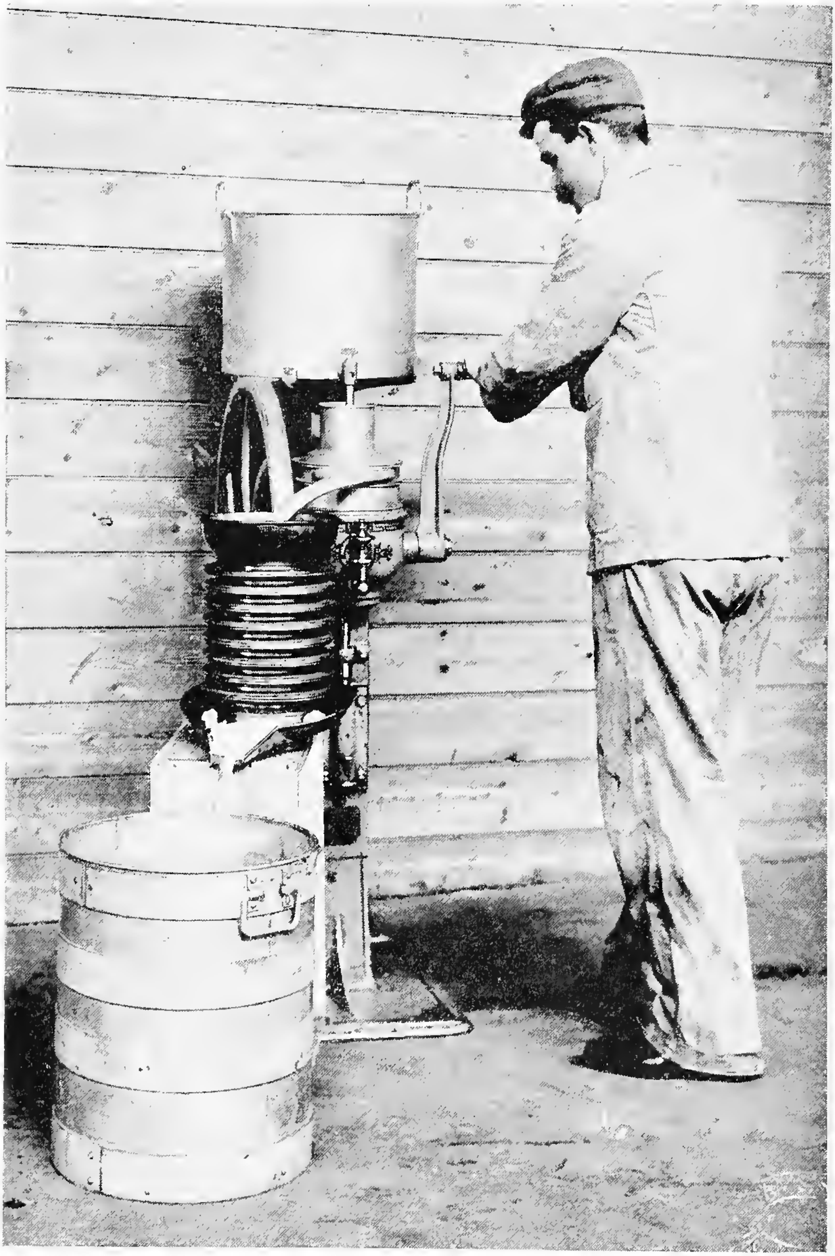
Milk is a great absorbent of bad odours, and a good medium for the development of bacteria. If the surroundings be evil-smelling, the milk will soon become tainted. The value of butter, therefore, becomes lessened as the contamination is permitted to increase in the milk. If a cow's udder is dirty it should be carefully washed, and if clean, it should at least be wiped. Such simple precautions prevent filth and dust from falling into the bucket when milking. Milking with dry hands is preferable, and is fast coming into favour. It is a much cleaner and better plan than the old way.

When the milk is strong in odour and flavour from such food as fresh green rape, lucerne, trefoil, turnips, &c., aeration greatly improves it. The aeration of milk has long been advocated; but because it was imperfectly understood, or entailed a certain amount of trouble, but few dairymen practise it. Milk that is quite nauseous to the taste, and gives off a strong undesirable odour from the above causes, can be made quite agreeable and palatable by aerating. The fact that the odour rises from the milk is proof that the element causing it is volatile. If pure air is passed through the milk, or if milk is spread out thinly and exposed to such air,



PIPE COOLER AND AERATER.

the undesirable element evaporates and is carried away. A simple experiment may be more convincing than any lengthy explanation. When



SEPARATOR AND CIRCULAR COOLER.

the milk is affected, take a cupful and pour it a few times from one cup into another. In doing so, let the milk fall some distance through the air.

After this is done a great improvement will be noticed. The same thing may be done by means of dippers or buckets; but when large quantities are handled special appliances have been designed—and are in the market—for effecting the object. The process is greatly assisted if carried out when the milk is at a high temperature immediately after coming from the cow.

Farmers reason in the following manner:—"My milk is considered good enough to be taken at the creamery without my going to any bother with it, and anything that is considered good enough to receive there is quite good enough to send." Again:—"If I put my milk in the best condition, and make it most suitable for manufacturing a tip-top quality of butter, and my neighbour does not, my good work is negatived by his carelessness as soon as our milk is mixed at the creamery. He gets as much for his product as I do, who supply a superior article." This contention applies to all milk inferior in condition, as well as from the neglect of proper aeration when necessary. This is really the weakest point in our otherwise excellent co-operative system of dairying.

The pastures, yards, and surroundings should be kept clean and free from all matter which may cause noxious smells.

Immediately the milk is drawn from the cow it should be strained through a wire and muslin strainer.

All buckets, cans, and other utensils with which the milk is brought in contact should be made of tin. *Rusty vessels* should *never* be used.

The milk vessels should be kept clean and sweet, and washed with cold or tepid water first, then scalded with boiling water or steam, and finished with a rinsing of lime water. They should afterwards be drained out, sunned, and aired.

Beestings, or milk from newly-calved cows, should not be used for skimming till after the *eighth* milking. Milk of some such cows is not fit for butter making for even a longer period, and should not be used until it is in suitable condition.

The milk should be cooled quickly to as low a temperature as possible, and this should be done in a clean place where there is no dust or smell. The Lawrence, pipe, or circular coolers, as shown in the illustrations, are the best.

It should be kept in a place where the atmosphere is free from foul or injurious odours. That which is left without the shelter of a roof should be protected from sun or rain by some other efficacious means.

A thermometer should be used to enable every dairyman to know the difference between the temperature of the atmosphere and available water, also the temperature of his dairy, milk, and cream.

The cans of milk should be kept in the *coldest* place. Night and morning's supply of milk should be kept in separate vessels, but may be mixed when at the same temperature.

Suppliers should furnish pure sweet milk, to which nothing has been added, and from which no part has been removed.

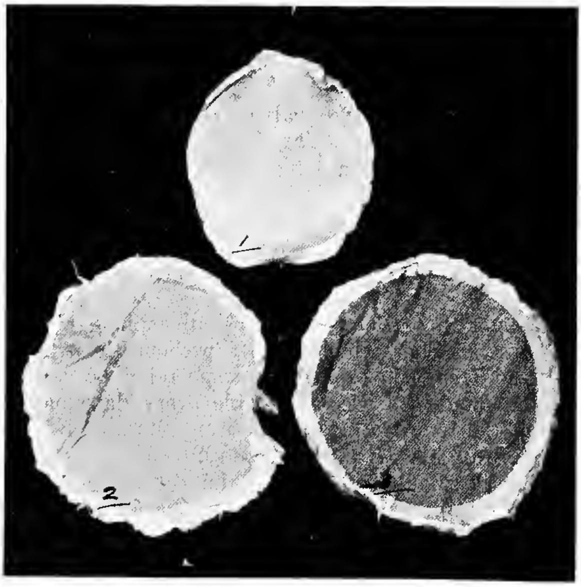
Factory and creamery managers are recommended to reject any milk which is considered as unfit for use in the manufacture of the *finest* quality of butter.

Persons engaged in milking should be always clean and tidy in their habits.

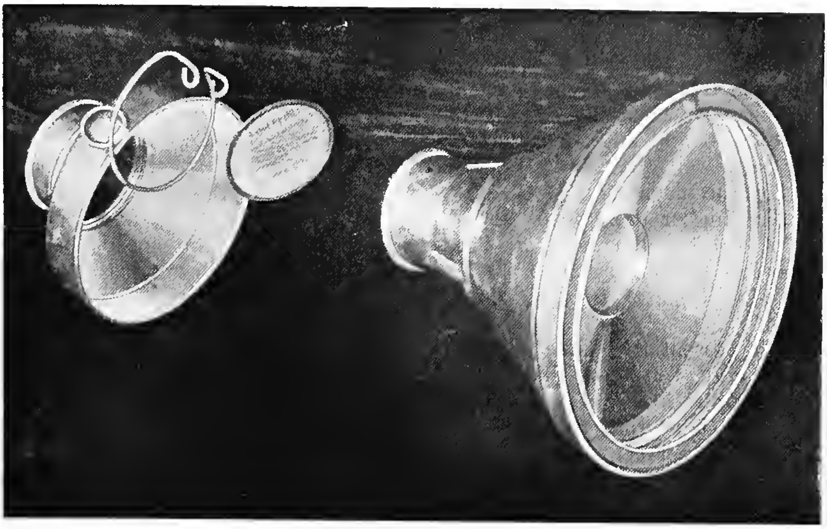
Wherever possible a well should be sunk, so as to secure a permanent supply of cold water.

Milk Straining.

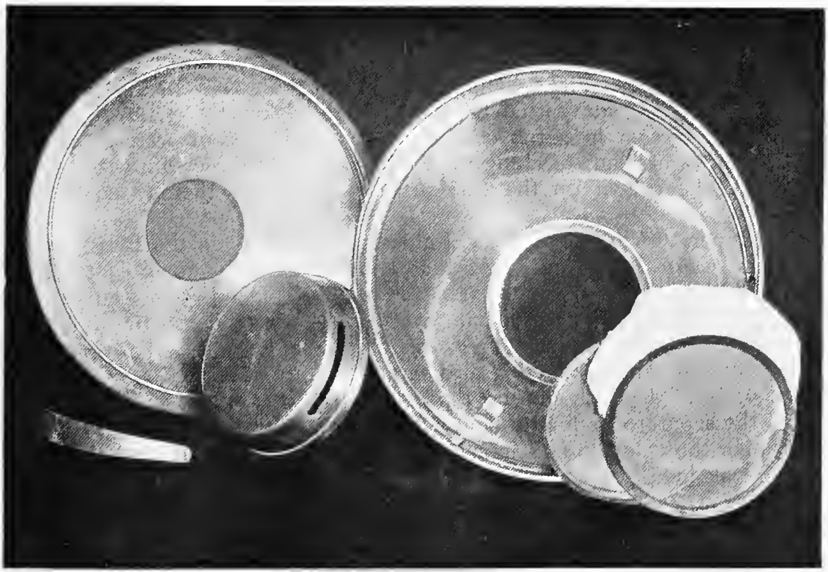
Although every care may be taken to keep milking yards and cowsheds clean, the cows groomed, the hands of the milkers and the udders and teats of the cows washed, it will still be impossible to prevent particles of dust, dandruff, hairs, &c., from falling into the milk. With ordinary milk strainers only the large particles are prevented from passing from the milking bucket into the cans. In addition to the usual wire gauze, therefore, two or four folds of butter-cloth should be used. Quite recently, cotton wool specially prepared for the purpose has been introduced, and as it more nearly approaches a filter than anything used in ordinary practice on the dairy farm, it restrains practically all the undissolved impurities. Each disc is burned after use, and a new one inserted for every milking, or about every forty gallons of milk, thus obviating all risk of contamination through strainers not being clean and sweet. Unfortunately, there are still some persons who consider straining unnecessary because the milk is only for the factory or creamery, or going to be separated. They fail to realize that as some of the impurities may have been dissolved by the time it reaches the separator, it is then too late to attempt to arrest the taints imparted to the milk, and all that can be done is to detain the coarser particles which may still be undissolved.



The accompanying illustrations show the effect of the improved strainer on milk. Fig. 1 is a disc of cotton wool before use, and Figs. 2 and 3 are discs through which 40 and 20 gallons of milk respectively have passed, and it will be seen that the last is very much the dirtiest. Both lots of milk had previously been run through five strainers, two of which were muslin.



IMPROVED MILK STRAINERS STAMPED OUT OF ONE PIECE.



PARTS OF LARGE SIZE IMPROVED MILK STRAINER.

Cream Separators.

The cream separator should be kept free from dust. Small particles of sand or gravel getting into the bearings will cause them to become hot when working, with the result that those parts get rough and worn and the machines run unsteadily. In addition to the cost of renewing the worn parts the skimming will be imperfect, and a serious loss of butter fat takes place. Use only oil of good quality. The use of cheap or inferior oils produces the same effect as the presence of grit on the bearings, and consequently shortens the life of the machine, impairs the efficiency of the work done, and adds considerably to the cost of repairs. Keep all working parts well oiled and free from dust. Do not use a brake of any sort to stop the machine.

The higher the rate of speed the better the separation, and more can be passed through with good results. The lower the speed the more imperfect the skimming, or to a certain point as good, but less work can be done. Separators should on no account be run much beyond their stated speed.

The essential points in good skimming are even temperature, even speed, and even feed. Separators should be checked daily in their work to see if any loss of fat is taking place. Machines are liable to go out of best form from time to time. In early separating days an average loss of under 0·15 per cent. of fat in the skim milk was considered good, whilst at the present time any average loss of over 0·05 is considered bad skimming. Thus 0·1 per cent. of loss in a farmer's average production of 4,000 gallons a year means in twelve months about 50 lbs. of butter not recovered. It will thus be seen that it pays to keep a sharp watch over the separators. The loss, of course, increases in accordance with more inefficient skimming of the machine.

Separate at a thickness producing about 10 gallons from 100 gallons of milk. Cool the cream immediately after separating. From underground tanks or wells cold water is always obtainable for this purpose. The cans of cream may be put down wells to keep them cool, or a small cellar, well drained, lighted, and ventilated may be used. Sometimes it will be best to stand the cream in a tub containing a few inches of water. Wrap a piece of clean hessian, reaching to the water, round the cream vessel. The water will be drawn up the hessian and evaporate, thereby cooling the cream.

A temperature of 80 degrees Fahr. is laid down as the most suitable temperature for skimming. At that temperature the cream is taken off cleaner and more readily than at a lower one. Good work can be done at a much lower temperature than 80 degrees, but to do so the milk must be passed through the machine more slowly. There is a danger of the cream clogging when skimming at a low temperature.

A sheet of lead should be dressed neatly over the top of the block before the separator is finally bolted in its place. There is then no difficulty in keeping the machine and its surroundings clean and sweet, as the grease cannot soak in.

MILK TESTING.

Short Instruction.

There are three vital points in milk testing that must be recognised in order to insure reliable results. The first is to secure a proper representative sample of the milk to be tested. The second is to get a true sample from the composite test bottle into the test flask. And the third point includes careful attention to all the remaining details of working.

PREPARING THE SAMPLE BOTTLES.

Composite samples give reliable results, and save the trouble of daily testing. Special graduated bottles are in the market, and may be obtained very cheaply. Rubber corks should be used, as they are easily kept clean and sweet. Pure formalin is the most satisfactory preservative for keeping the samples. Three drops of formalin added with a medicine-dropper is sufficient to put in the composite bottle. The bottles should be thoroughly cleansed after each testing is done. For use on the farm the names or numbers of the cows can be attached to the neck of the bottles.

SECURING THE SAMPLES.

After a cow is milked, and the milk weighed, pour it from one bucket into another and then back before taking the sample. Immediately afterwards take some with a cup or measure, and put some into the composite bottle. The same quantity should be added each time, and at the end of each week the bottle will contain a representative sample of the milk for that period. In a factory or creamery the drip system is the most reliable.

MEASURING THE TEST SAMPLE.

The contents of the composite bottles should be thoroughly mixed. If the cream has set or is hard to mix, the bottles should be placed in warm water at a temperature of 120 deg. for a few minutes. The cream is then more easily dissolved and mixed with the milk. A bottle-extender greatly facilitates the mixing when the bottles are too full to shake. The sample is measured with a 17·6 c.c. capacity pipette, and put in the test flask. To prevent spilling, the flask should be held at an angle to allow the air to escape.

THE SULPHURIC ACID.

For milk-testing, sulphuric acid of 1·827 specific gravity is used. Special hydrometers for ascertaining the strength of the acid cost 3s. 6d. each, and a glass jar for holding the acid 1s. 6d. When using the hydrometer, the temperature of the acid should be 60 deg. Fah. Never put a metal or wooden-frame thermometer in the acid; only glass or porcelain vessels should be used. The acid bottle should be kept corked when not in use, as it absorbs moisture from the air if exposed, and becomes weak. The acid and milk ought to be about 70 deg. in temperature before mixing. It is neglect of temperature and strength of acid that causes a white curdy matter, or a black charred substance, to appear in the fat column. This temperature may be secured by placing the test bottles in a water-bath of the desired heat after measuring. The acid may be cooled or heated in the same manner, but before measuring. Altering the strength or quantity of the acid is not recommended. All bottles containing sulphuric acid should have glass ground stoppers. The bottles should always be labelled " Poison," and kept out of the reach of children when not in use.

MEASURING THE ACID.

The acid is measured with a 17·5 c.c. glass measure, and poured down the inside of the neck of the test flask without disturbing the milk. The test flask should be held at an angle to allow the air to come out as the acid goes in, to prevent spilling. The test samples may be shaken separately by hand or together in a cradle. It is possible to dissolve the milk in less than the quantity of acid added, and sometimes a clear layer of acid remains at the bottom. This can be overcome by giving the bottles a good shaking with a reverse motion before finishing.

WHIRLING THE BOTTLES.

The speed at which the machine has to be turned depends on the gearing, and the diameter of the testers. If the bottle-wheel of the machine is 12 inches in diameter, that wheel should be made to turn 980 times per minute. If 18 inches in diameter, 800 revolutions per minute; and if 24 inches in diameter, 693 revolutions per minute. If the bottle-wheel is 18 inches in diameter, and geared to revolve ten times for one turn of the handle, the operator should turn the handle eighty times per minute to attain the necessary speed. If the bottle-wheel be geared by friction, care should be taken that no slipping takes place. For factory or creamery use the steam-turbine machines are far preferable to the others.

ADDING THE WATER.

After turning the tester for six minutes, hot water, 180 deg., is added up to the neck of the flasks. Rain or soft water should be used for this purpose. After adding the water, the machine is turned for three minutes, then more water is added to bring the liquid up in the neck of the flask to between the 7 and 10 mark. Another minute's turning, and the operation is complete. If only a few samples are to be tested, the water may be added with the milk pipette; but where a large number have to be done, a can with a rubber tube and a pinch-cock is handiest.

READING THE TESTS.

A pair of fine-pointed dividers is of great assistance in taking the measurement of the fat column. The fat is measured from the lower line between it and the water to the top of the column. Having taken that span with the dividers, one point is placed at 0, and the other will show the percentage of fat on the scale on the neck of the bottle. Each large division represents 1 per cent., and each small space two-tenths, or 0·2 of 1 per cent. In very cold weather the fat column often partly solidifies before a reading can take place. This may be prevented by keeping up the temperature of the samples. Hot water may be put in the pan of the machine, and the test flasks placed in warm water after whirling is finished, until the readings are recorded. This precaution is not necessary for the greater part of the year.

COMPUTING THE BUTTER CONTENTS.

In order to arrive at the commercial butter contents in milk per the respective butter-fat percentages, it is necessary to deduct a small loss that takes place in skimming, plus another loss that occurs in churning, and then add a percentage to make up for the usual quantity of water, curd, and salt contained in commercial butter. As the net addition is different with each test it is impracticable, as well as a waste of time, to work out each result by such a roundabout method. The following table of test values agrees with the Babcock table adopted by most of our factories. All milk should be reduced to butter, per its test, before quoting its money value. This system is more precise and equitable than differential rates per gallon, and is not liable to many misleading and complicated interpretations. Many useful hints, together with detailed instructions, are generally issued by the makers of each machine. Beginners should take a few lessons in the use of the Babcock tester from some one who has had experience. The percentage added as the equivalent of the water, &c., is called the "over-run."

VALUE OF TESTS. BABCOCK TESTER.

Tests.	Lbs. of Milk required to make 1 lb. Butter.		Tests.	Lbs. of Milk required to make 1 lb. Butter.	
	Correctly in Decimals.	Approximately in Fractions.		Correctly in Decimals.	Approximately in Fractions.
3·0	30·58	30½	4·1	21·94	22
3·1	29·58	29½	4·2	21·35	21¼
3·2	28·51	28½	4·3	20·81	20¾
3·3	27·62	27½	4·4	20·29	20¼
3·4	26·73	26¾	4·5	19·80	19¾
3·5	25·90	26	4·6	19·34	19¼
3·6	25·15	25	4·7	18·89	18¾
3·7	24·45	24½	4·8	18·46	18½
3·8	23·74	23¾	4·9	18·06	18
3·9	23·12	23	5·0	17·67	17¾
4·0	22·52	22½			

To compute the number of pounds weight of butter contained in milk—

Divide the pounds and decimals of a pound, of milk agreeing with the test result, into the total number of pounds of milk.

Example.—1,000 lbs. of milk tests 4·0 per cent. butter fat.

It will be seen above that it takes 22·52 lbs. of milk testing 4·0 to make one pound of butter.

```
Therefore :—22·52)1000·00(44·4
                  9008
                  ----
                   9920
                   9008
                   ----
                    9120
                    9008
                    ----
                     112
```

44·4 lbs. of butter are computed to be contained in 1,000 lbs. of milk with a 4·0 test.

Alteration of Method Necessary.

This system of computing butter contents has been in almost universal use in Victoria for the last twelve years, and provides the necessary corrections as originally worked out by Dr. Babcock.

Recent disclosures, coupled with long experience of the method, render it imperative to substitute some simpler method, which, being free from the over-run, does not lend itself so readily to chicanery and juggling. The above table is left in on account of the subsequent useful tables and deductions which have been worked out according to it. *The method of the future*, which it is to be hoped will be made universal, *consists of the payment for pure butter fat alone.* The percentage is easily estimated or checked, and the total readily arrived at. In testing cows the new method is recommended for future use.

MONTHLY CHART.

for the guidance of Dairymen in recording each Cow's Milk.

NAMES OF COWS.																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DATE	LBS MILK	LBS MILK	LBS MILK	LBS MILK	LBS. MILK	LBS. MILK	LBS MILK	LBS MILK	LBS. MILK	LBS. MILK	LBS. MILK	LBS MILK	LBS MILK	LBS MILK	LBS. MILK	LBS MILK	LBS MILK	LBS MILK	LBS MILK	LBS MILK	LBS MILK	LBS MILK	LBS MILK	LBS MILK
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30																								
31																								
TOTAL																								
TESTS 1ST WEEK																								
2ND „																								
3RD „																								
4TH „																								
AVERAGE																								

Scale—One-third of Practical Size.

COMPUTING THE BUTTER FAT CONTENTS.

The reading on the neck of the flask represents the percentage of pure butter fat in the milk. To find out the total amount of fat contained in the milk, multiply the weight of milk by the test, and divide the product by 100.

EXAMPLE.—2,240 lbs. of milk, testing 4 per cent. fat, 2,240 x 4 equals 8,960, divided by 100 equals 89·60 lbs. of butter fat.

This does not represent the butter as sold to the consumer, for in addition to fat, water, curd, salt, &c., are contained, amounting to an average of about 17 per cent., over-run so that 100 lbs. of butter fat in the milk would make about 117 pounds of commercial butter. The percentage of water in the butter, however, from a variety of causes, is a variable quantity, ranging from, in extreme cases, 8 per cent. to 20 per cent., so that it will readily be seen that a hard-and-fast rule cannot be made in estimating the amount of butter that should be made from a given quantity of butter fat. In estimating the value of a cow, 17 per cent. as the average over-run may be added to compute the amount of commercial butter contained in her milk.

THUS.—89·60 x 17, divided by 100, equals 15·23 the over-run; 89·60 plus 15·23 equals 104·83 pounds of commercial butter.

COW LEDGER FOR RECORDING EACH COW'S MILK FOR THE YEAR.

BEAUTY.

(Calved 26th July.)

Month.	Milk.	Test.	Butter.	Price.	Value.		
	galls.				£	s.	d.
July							
August	146	3·4	54·6	8d.	1	16	4
September	152	3·4	56·8	,,	1	17	10
October	142	3·5	54·8	,,	1	16	6
November	128	3·5	49·4	,,	1	12	11
December	116	3·6	46·1	7d.	1	6	10
January	97	3·7	39·6	,,	1	3	1
February	52	4·0	23	8d.	0	15	4
March	34	4·1	15·9	1s.	0	15	10
April	12	4·3	5·7	,,	0	5	8
May							
June							
Total	879	..	345·9	..	11	10	4

The Utility of Testing Cows.

The accompanying table of the actual return of a small dairy herd of Victorian cows has been compiled with a view of impressing on dairymen the great advantage to be derived from recording the results from each and every cow. It is all very well to judge a cow by appearances, but practical men are well aware that many a fine-looking cow is unprofitable for the dairy. At the present time it is fully recognised that there is no way so reliable to tell a good cow from a bad one as scales and Babcock tester. The average Victorian cow has the reputation of giving a very small return as compared with the cows of many other countries. Whether this is so or not is open to question, and would be a difficult query to settle definitely. From previous records it would appear that Victoria possesses some cows almost as good as are to be found in any part of the world. No doubt the greater number are anything but profitable for dairying. If bad cows were known for certain and weeded out, and the remaining cows received better attention, our prospects would be bright indeed in the dairying line.

DESCRIPTION OF HERD.

The herd of cows under review is a cross-bred one. There is more shorthorn blood in them than anything else— about three-quarters shorthorn and the rest a mixture, but no Channel Island blood whatever.

METHOD OF TREATMENT.

They did not receive any special attention. The cows were treated alike, and they were all pastured together. With the exception of a limited supply of small potatoes for a few weeks, the cows had nothing but straw in addition to pasture. In common with herds in many parts of the State that season, this one was reduced to skin and bone for some months. As a consequence, the cows did not, at their best, give more than three-fourths of the yield of a normal season. They were kept in the Koroit district, and the dairy formed an auxiliary to other branches of farming. Cows going out of milk at the beginning of the year and disposed of are not included. Neither are heifers coming in before the close of the year. All cows are quoted that could be said to be on the farm the year round. Some of those milked for six months and others up to eleven months.

TABLE NO. I.

SUMMARY OF RETURNS FOR ONE YEAR.

(*Compiled by R. Crowe.*)

No.	Name.	Milk.	Test.	Butter.	Price.	Value.		
		Gallons.		lbs.	d.	£	s.	d
1	Caroline	697	4·2	326·41	8	10	17	7
2	Star	641	4·2	300·18	8	10	0	1
3	Spot	630	4·2	295·03	8	9	16	8
4	Lottie	683	3·6	271·55	8	9	1	0
5	Bess	531	4·5	268·04	8	8	18	8
6	Kitty	563	4·2	263·65	8	8	15	9
7	Lily	509	4·6	263·15	8	8	15	5
8	Stumpy	732	3·2	256·63	8	8	11	1
9	Fanny	575	4·0	255·24	8	8	10	1
10	Flo	697	3·3	252·31	8	8	8	2
11	Bawley	619	3·6	246·12	8	8	4	0
12	Mary Ann	662	3·3	239·64	8	7	19	9
13	Jenny	670	3·2	234·89	8	7	16	7
14	Blossom	666	3·2	233·49	8	7	15	7
15	Polly	587	3·6	233·38	8	7	15	7
16	Snaily	521	4·0	231·27	8	7	14	2
17	Judy	502	3·8	211·44	8	7	0	11
18	Rosy	594	3·2	208·24	8	6	18	9
19	Lady	435	3·9	188·13	8	6	5	5
20	Bonny	430	3·9	185·97	8	6	3	11
21	Dolly	421	3·8	177·32	8	5	18	2
22	Molly	392	4·0	174·01	8	5	16	0
23	Matilda	492	3·2	172·48	8	5	14	11
24	Liz	399	3·8	168·05	8	5	12	0
25	Princess	409	3·7	167·28	8	5	11	6
26	Betty	385	3·9	166·56	8	5	11	0
27	Cherry	375	4·0	166·46	8	5	10	11
28	Nelly	471	3·2	165·12	8	5	10	0
29	Violet	359	3·8	151·20	8	5	0	9
30	Gloss	347	3·8	146·15	8	4	17	5
31	Redmond	365	3·6	145·11	8	4	16	8
32	Pansy	299	3·7	122·29	8	4	1	6
		16,658	..	6,886·79	..	229	10	0

ANALYSIS OF SUMMARY.

The average number of pounds of milk required to make a pound of butter was 24.19.

The average return in milk per head was 520 gallons, of butter 215.21 lbs., and in money £7 3s. 5d.

The return in milk from the best cow was 697 gallons, from the ten best an average of 625 gallons, from the ten worst an average of 390 gallons, and from the worst cow 299 gallons.

The return in butter from the best cow was 326.41 lbs., from the ten best an average of 275.21 lbs., and from the ten worst an average of 157.07 lbs., and from the worst cow 122.29 lbs. The return in money from the best cow is £10 17s. 7d., from the ten best an average of £9 3s. 5d., from the ten worst an average of £5 4s. 8d., and from the worst cow £4 1s. 6d.

STRIKING DEDUCTIONS.

In order to make the lesson more instructive, it is assumed that the cost of each cow's keep for a year amounts to £2 10s., and the cost of attention to £1 10s. This £4 is estimated to sufficiently provide for rent or interest on the investment for each cow's keep, and the labour involved. Anything returned over that sum may be looked upon as profit. Therefore the best cow gives a profit of £6 17s. 7d., the ten best average £5 3s. 5d., the ten worst average £1 4s. 8d., and the worst cow a profit of 1s. 6d. The best cow gives over 91 times as much profit as the worst one, and the profit from the ten best cows amounts to nearly the gross return from the ten worst cows.

AN INTERESTING COMPARISON.

Many dairymen believe in cows that give a large quantity of milk; others believe only in cows that give a good test. Both are right to a certain degree, and to be safe, the quantity as well as the quality must be taken into account.

Attention is directed to the two cows, Nos. 7 and 8. The latter gives 223 gallons more milk than the former and yet brings in less money. Both are almost equally profitable cows, although one gives a 4.6 test and the other only 3.2. The goal can really be secured by widely-differing routes.

ANOTHER COMPARISON.

In looking over the monthly charts containing the records of those cows, it is found that "Lady," No. 19, gives the largest quantity for that period. The following monthly comparison is interesting:—

No.	Galls. Milk.	Test.	Butter.	Price.	Value.
19	... 140 ...	3.7 ...	57.26 ...	8d. ...	£1 18s. 2d.
2	... 89 ...	3.7 ...	36.40 ...	8d. ...	£1 4s. 3d.

The best return for a month by cow No. 2 is quoted, and in the monthly comparison No. 19 cow would get credit for being by far the more profitable animal. However, in looking at the year's record, it is found she was only a sprinter. For the month No. 19 gives 13s. 11d. more than No. 2., but for the year No. 2 gives £3 14s. 8d. more than No. 19. The one cow gave a big yield for a short period. The other did not give a big flow, but was a consistent milker, and came out best.

CHEAPENING COST OF PRODUCTION.

If it cost £4 to produce 326 lbs. of butter with the best cow, and the same amount to produce 122 lbs. of butter with the worst cow, then it has cost less than 3d. per lb. to produce butter from the good cow, and almost 8d. per lb. with the bad one.

A PROBLEM.

A herd that would give an average return of £7 3s. 5d. under such conditions, and in a year described by the oldest residents as the worst experienced for 30 years past, would be designated a picked herd. Therefore, this may be termed a picked herd, and if the individual members of a picked herd vary so much in the returns given by them, it would be most interesting to know to what extent the results of an average herd would differ when recorded in the same way.

GREAT POSSIBILITIES.

If such returns can be obtained under such adverse circumstances by an ordinary mixed herd of cows in Victoria, what is it possible to secure from a herd, say, like the ten best cows in a favorable year? It is said that the average return from Victorian cows is 290 gallons—not equal to that of the worst cow here quoted. The ten best cows have two and a quarter times that of the worst cow, so it can easily be seen what scope for improvement lies in this direction.

If it has been worth our while building up an industry of the magnitude—local and export—of £2,500,000 with the indifferent cows we are credited with, it will not be a hard matter to more than hold our own against all countries in the world if we pay more attention to the breeding, feeding, and management of our cattle. To say that we are not making headway in this direction would not be true. In every district there are to be found a few up-to-date dairymen, who serve as splendid examples to the remainder, and who are ever ready to adopt improved methods. This system of recording the quantity of each cow's milk, together with the quality, is strongly recommended. The beginning is the hardest part of it. Give the plan a trial, and you will find the trouble or delay not nearly so much as it appears. In a short time it will become part of the routine of milking, and the information continually gained will far outweigh the little extra attention. What better technical education can be afforded the young people who usually do the milking; and what a splendid thing it is to know definitely which cows are worth keeping and breeding from.

TABLE No. 2.

LESSON FROM TABLE No. 1.

Milk Yield.

Milk from the best cow was	697 galls.
Average milk from the 10 best cows was	625 ,,
,, ,, 10 worst ,, ,, ...	390 ,,
,, ,, worst cow ,, ...	290 ,,

Butter Yield.

		£	s.	d.
Butter from the best cow equalled	326·41 lbs. at 8d. ...	10	17	7
,, ,, 10 best cows averaged	275·21 ,, ...	9	3	5
,, ,, 10 worst cows ,,	157·07 ,, ...	5	4	8
,, ,, the worst cow was	122·29 ,, ...	4	1	6

TABLE No. 2—*continued.*

LESSON FROM TABLE No 1—*continued.*

Profits.

	£	s.	d.
Allowing £2 10s. per cow for feed and £1 10s. for labour and other expenses, or £4 in all, the best cow gave a profit of	6	17	7
The 10 best cows averaged a profit of	5	3	5
The 10 worst ,, ,, ,, ...	1	4	8
The worst cow gave a profit of	0	1	6

Cost of Production.

326 lbs. from best cow cost £4, or 2·94d. per lb.
122 lbs. ,, worst ,, £4, or 7·86d. ,,
"Caroline" gives over 90 times as much profit as "Pansy."

Deduction.

	£	s.	d.
30 cows equal to the 10 best would give net profit for the year of	155	2	6
30 cows equal to the 10 worst would give net profit for the year of	37	0	0

It would take 126 such cows as the latter to give a net return of £155

Therefore 30 cows like the best would give a net return equal to 126 cows of the latter standard.

TABLE No. 3.

General.

Average lbs. of milk per lb. of butter	24.19 lbs.
,, quantity of milk per head	520 galls.
,, ,, butter ,, ...	215·21 lbs.
,, money value per cow at 8d. per lb.	£7 3 2

Scales and Test.

Quantity and quality must be considered together.

	£	s.	d.
No. 7 gave 509 galls., 4·6 test, equal to 263·15 lbs. butter at 8d.	8	15	5
No. 8 gave 732 galls., 3·2 test, equal to 256·63 lbs. butter at 8d.	8	11	1
No. 8 gave 223 galls. more milk than No. 7.			
No. 7 beats No. 8 by 6·52 lbs. butter at 8d.	£0	4	4

Persistency.

	£	s.	d.
No. 19, "Lady," for 1 month gave 140 galls., 3·7 test, equal to 57·26 lbs. butter at 8d.	1	18	2
No. 2, "Star,"for 1 month gave 89 galls., 3·7 test, equal to 36·4 lbs. butter at 8d.	1	4	3
Or No. 19 gave 13s. 11d. more than No. 2	£0	13	11

For twelve months—

	£	s.	d.
No. 2 gave 641 galls., 4·2 per cent., equal to 300·18 lbs. butter at 8d.	10	0	1
No. 19 gave 435 galls., 3·9 per cent., equal to 188·12 lbs. butter at 8d.	6	5	5
No. 2 beat No. 19 by	£3	14	8

When testing cows, a sample of milk for three days in succession should be taken, because of the variation of percentage of fat from day to day. Having milked the cow, weigh the milk and record the weight on the chart, which should be tacked on a board hanging near the scales. Then pour the milk from one bucket to another four times, and immediately put about two tablespoonfuls into a bottle. To this add three drops of pure formalin; add an aliquot part of the milk from each milking. The formalin will keep the sample good until ready for testing. As an alternative, a sampling tube will be found convenient for taking a representative and proportionate sample of the milk. This tube is of nickelled copper, about 15 inches long and ⅜-inch diameter, with openings in the side. It is lowered into the milk, and, when full, the openings are closed by an attachment, and the contents poured into a bottle.

The returns of a heifer for the first year are not always a reliable guide as to her future value in the herd. If she is of promising appearance, another year's trial should be given.

TESTING MILK FOR FACTORIES, CREAMERIES, AND MILK SUPPLIERS.

In case of disputes arising between milk suppliers and managers of butter factories and creameries regarding the percentage of butter fat contained in any supplier's milk, the expert attached to the dairy section of the Department will test samples of milk free of cost by either visiting the factories or creameries, or receiving a sample of milk that has been collected by the "drip" system by the manager, and testing it in the Department's laboratory, Melbourne.

Dairy farmers desirous of receiving instruction in the process of testing milk by the "Babcock" tester, by applying to the Secretary for Agriculture will be taught in Melbourne the proper method of using the appliances necessary for that purpose by the Department's experts.

Cream Testing.

TAKING THE SAMPLE.

The first consideration is to obtain a correct sample, and this is best done with a sampling tube, which is made of glass or metal, fitted with a plunger, long enough to take a core the full depth of the cream in the can from top to bottom. The plunger is held stationary at the top and the tube pressed down through the cream. When the bottom is reached the sample is withdrawn, the finger placed over the end of the sampler to prevent the escape of any liquid till the end of tube is above or inserted into a glass bottle, or jar of delf or tin, when the plunger is forced down and the cream caught in the jar. Having taken all the samples, the jars are stood in water at about 100 degrees Fah. to facilitate mixing.

WEIGHING THE CREAM.

The accompanying illustration is that of scales well adapted for this purpose. Six cream flasks are placed in the frame and balanced by a counterpoise in the pan and poise weights on the beam. A very handy counterpoise will be found in a cream flask with the neck broken off, in which water is placed, and can be removed drop by drop with a pipette, or small shot will be found convenient. It will sometimes be found best to place this in the centre of the frame. In this way six flasks are balanced at once in the same time as it would take to balance one on ordinary scales. When balanced a nine gram weight is placed in the pan, and nine grams of cream in No. 1 bottle, another nine gram weight placed in the pan, and nine grams of another sample in No. 2 flask, and so on until the six flasks are used. These are removed, and six more balanced. When a machineful is weighed, about nine cubic centimetres of water are added to each flask and shaken up, 17·5 c.c. sulphuric acid added as in milk, and the samples are then treated the same as milk.

READING THE SAMPLES.

As we have only taken nine grams of the cream for a test, and the proper amount would be eighteen grams, we read off the fat in the neck of the flask, and double it; this gives the correct percentage of fat in the cream.

TO ESTIMATE THE AMOUNT OF BUTTER DUE TO EACH CREAM SUPPLIER.

Take the net weight of cream, multiply by the test, and divide by 100; this gives the total fat.

Example—

No. 1 supplier, 92 lbs. cream, 55 test ... $\frac{92 \times 55}{100}$ equals 50·60 total fat.

Treat each supplier's cream in the same way, say:—

Supplier No.	1 ...	92 lbs. net cream ...	55 test ...	50·6 total fat
,,	2 ...	84 ,, ...	40 ,, ...	33·6 ,,
,,	3 ...	60 ,, ...	25 ,, ...	15·0 ,,
,,	4 ...	55 ,, ...	30 ,, ...	16·5 ,,
,,	5 ...	80 ,, ...	45 ,, ...	36·0 ,,
,,	6 ...	37 ,, ...	60 ,, ...	22·2 ,,
		408		173·9

Butter made that day—209 lbs.

To find the over-run or difference between butter fat and commercial butter:—

Example—

209	commercial butter
173·9	butter fat as per test.
35·1	difference—over-run.

To find the percentage to be added to each supplier—Multiply the over-run by 100, and divide by the total fat.

Example— 1,739)35,100(20 per cent. over-run.

34·78

·320

Take No. 1 supplier as an example —

Multiply the fat by the over-run, and divide by 100; this gives the amount of his share of the over-run.

Thus— 50·6 lbs fat.

20 per cent.

10·120

FAT PLUS OVER-RUN EQUALS COMMERCIAL BUTTER.

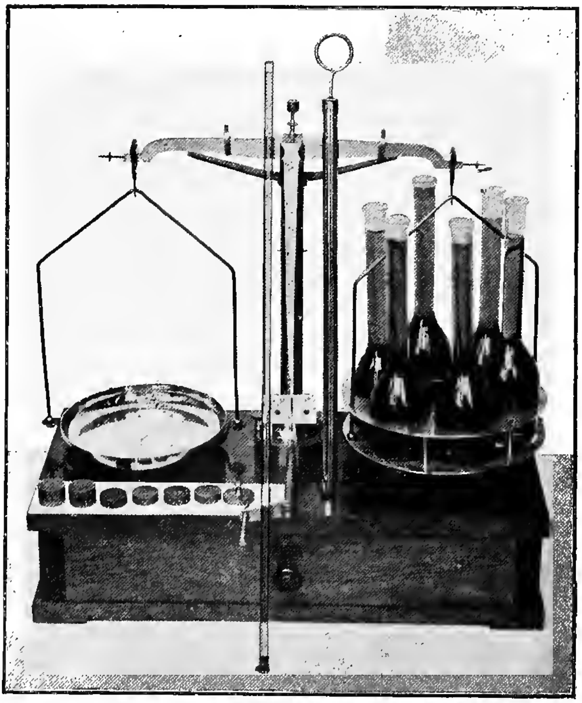
50·6 fat.
10·12 over-run.

60·72 commercial butter.

Treat each supplier in the same way, obtaining the following result:—

—	Net Cream.	Test.	Total Fat.	Total Butter.	Percentage of Over-run.	Butter.
	lbs.	%			%	
1	92	55	50·6	..	20	60·72
2	84	40	33·6	..	20	40·32
3	60	25	15·0	..	20	18·00
4	55	30	16·5	..	20	19·80
5	80	45	36·0	..	20	43·20
6	37	60	22·2	..	20	26·84
	408	..	173·9	209	..	208·88

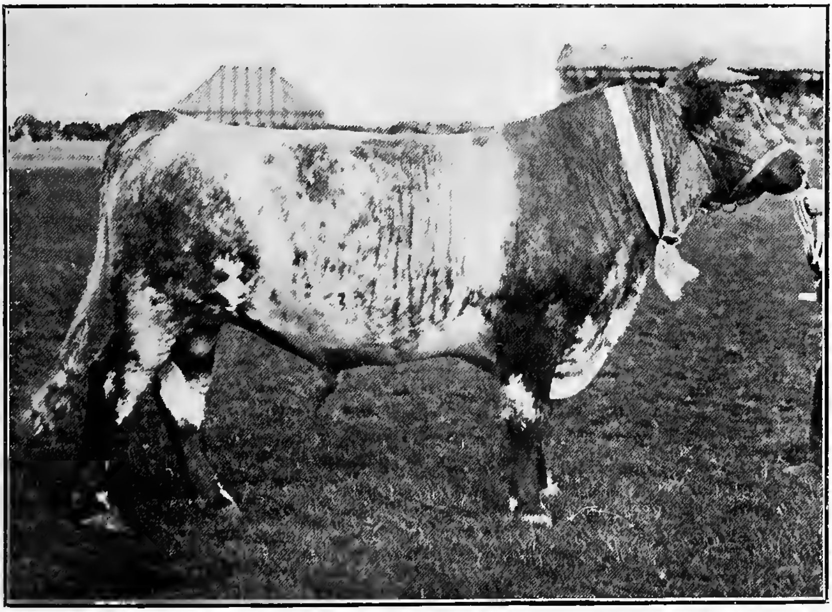
It will be found that it is almost as easy and quick to work out each supplier's return as to refer to a chart. Also a chart and ready reckoner would be required to represent the various percentages of over-run which will be found to vary from day to day.



SCALES FOR WEIGHING CREAM.

SOME LEADING BREEDS OF DAIRY CATTLE.

Chief amongst the breeds recognised in this country as dairy cattle are the Shorthorn, Ayrshire, and Jersey. Some other dairy breeds are represented, namely, Holstein, Kerry, Guernsey, &c. The Holstein and Guernsey, at least, are worthy of more attention than they have had hitherto, for amongst some of our best butter records are those from the Holstein cross, while the Guernsey are of a similar nature to the Jersey, but larger in size, while they give large quantities of rich milk of a high colour. Amongst the breeds which are looked upon purely as beef breeds there are often found strains and individuals that are first-class butter producers. For instance, one of the best dairy herds in Gippsland, that of Mr. Langham, of Korumburra, is pure Hereford, and we have known individuals of the Polled Angus give as much as 17 lbs. of butter per week.



SHORTHORN BULL "THE SKIPPER."

Shorthorns.

Most people in Australia are inclined to class the Shorthorn as a beef and not a dairy breed, and that is due entirely to the general neglect of the milking strain and the milking properties of the breed, while, in England, to use the words of Professor Sheldon, "The Shorthorns may, with confidence, be placed as one of the best half-dozen milking breeds to be found anywhere, and that as all-round cattle they cannot be surpassed, if indeed equalled, by any other breed in the world. . . . . If we draw attention to the remarkable facts that the Shorthorns have, during the past century, become more widely and numerously diffused than any other breed throughout the dairying districts of England and Ireland, not to mention Scotland

and Wales; that over large areas of country they have displaced or are displacing other breeds, against which process there is at present no reaction worth the name, enough is said to show that the premier breed possesses superior and commanding merits as milk producers. All this is in no respect the result of mere undesigned and accidental fashion, but due to the well-ascertained fact that as milkers, as breeders, and as fatteners, Shorthorns are superior to the breeds which they have displaced."

That we have good milking Shorthorns in this country will be seen from the accompanying illustration. The bull, "The Skipper," took first and champion prizes for milking Shorthorns at the Royal Show, Melbourne, 1904, and is the property of Mr. P. H. Morton, and was bred by Mr. W. G. Roberts. The cow, "Queenie 3rd," was awarded first and champion prizes for milking Shorthorns at the Royal Show, Melbourne, 1903; at the same show, she secured first for the cow giving the greatest quantity of milk, and was third in the butter test. In 1904, at the Royal Show, this cow was awarded first and champion for milking Shorthorns. "Queenie 3rd" is the property of and was bred by Mr. R. Lidgett, Myrniong.

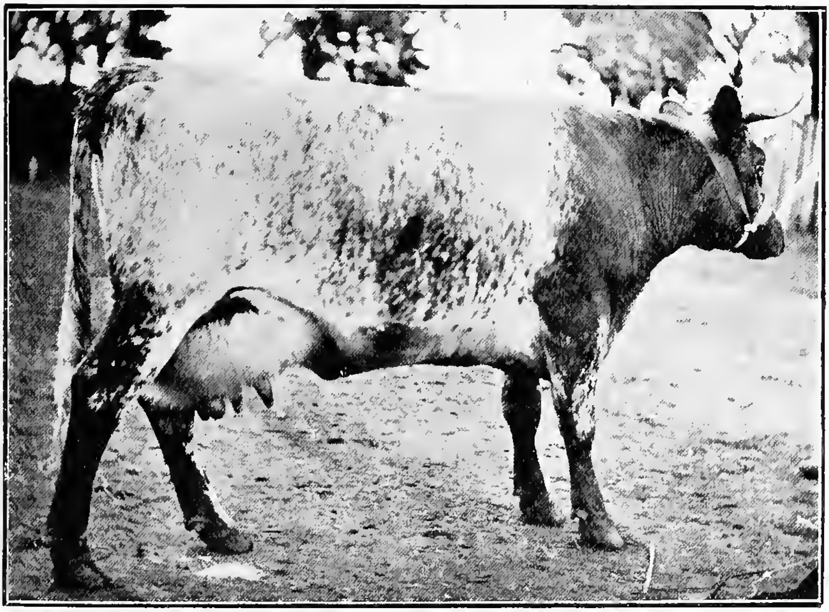
In the *Leader* of 24th June last are given the records of a dozen of Mr. W. T. Manifold's pure Shorthorn cows at Purrumbete, and they should be of sufficient value to reproduce here:—

Days in Milk.	lbs of Milk.	Butter Fat Test.	lbs. of Butter.
270	7,530	3·9	317
330	7,230	4·0	320
330	6,910	5·2	407
240	7.320	4·3	351
330	7.890	4·0	350
300	7,530	4·2	352
360	6,780	4·6	350
356	6,810	4·3	326
360	6,390	4·6	330
300	7,530	4·1	342
240	6,660	4·2	311
330	8,640	3·9	373

This is truly a magnificent record, and bulls from such cows should be almost invaluable for the improvement of dairy herds.

THORNTON'S DESCRIPTION OF THE SHORTHORN.

The breed is distinguished by its symmetrical proportions, and by its great bulk on a comparatively small frame, the offal being very light, and the limbs small and fine. The head is expressive, being rather broad across the forehead, tapering gracefully below the eyes to an open nostril and fine flesh-coloured muzzle. The eyes are bright, prominent, and of a particularly placid, sweet expression, the whole countenance being remarkably gentle. The horns (whence comes the name) are unusually short, springing well from the head, with a graceful downward curl, and are of a creamy, white, or yellowish colour, the ears being fine, erect and hairy. The neck is moderately thick (muscular in the male), and set straight and well into the shoulders, which when viewed in front are wide, showing thickness through the heart, the breast coming well forward, and the fore legs standing short and wide apart. The back among the higher bred animals is remarkably broad and flat, the ribs barrel-like sprung well out of it and with little space between them and the hip bones, which are soft and well covered. The hind quarters are long and well filled in, the tail being set square on to them, the thighs meet low down, forming the full and deep twist, the flank should be deep so as to partially cover the udder, which should be not too large, but placed well forward, the teats being well formed, square-set, and of medium size, the hind legs should be very short and stand wide and quite straight to the ground. The general appearance should show even outlines. The whole body is covered with long soft hair, there frequently being a fine undercoat, and this hair is of the most pleasing variety of colour, from a soft creamy white to a full deep red. Occasionally the animal is red and white, the white being found principally on the forehead, underneath the belly, and a few spots on the hind-quarters and legs; in another group the body is nearly white, with the head and neck partially covered with roan, while again, the body is most beautifully variegated of a rich deep purple or plum-coloured hue. On touching the beef points, the skin is found to be soft and mellow as if lying on a soft cushion. In animals thin in condition, a kind of inner skin is felt, which is the "quality" or "handling" indicative of those great fattening propensities for which the breed is so famous.

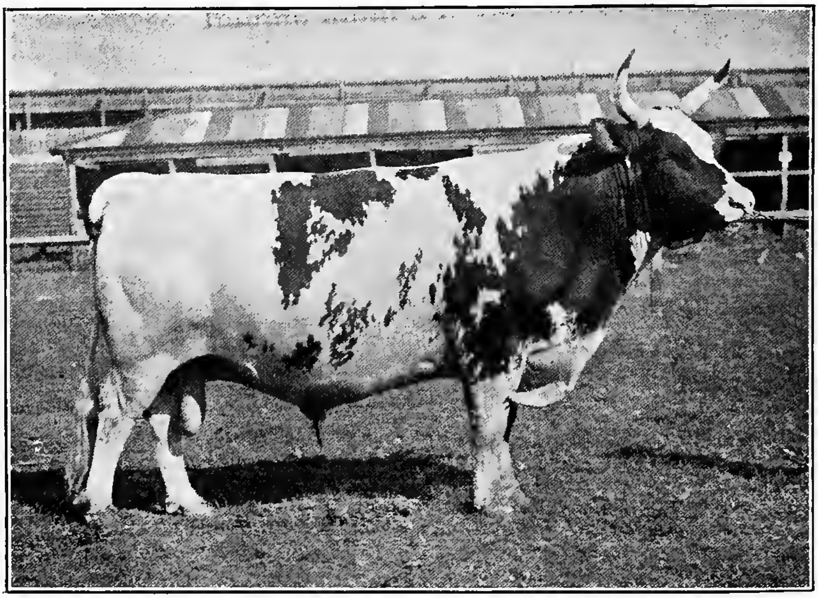


SHORTHORN COW, "QUEENIE 3RD."

Ayrshires.

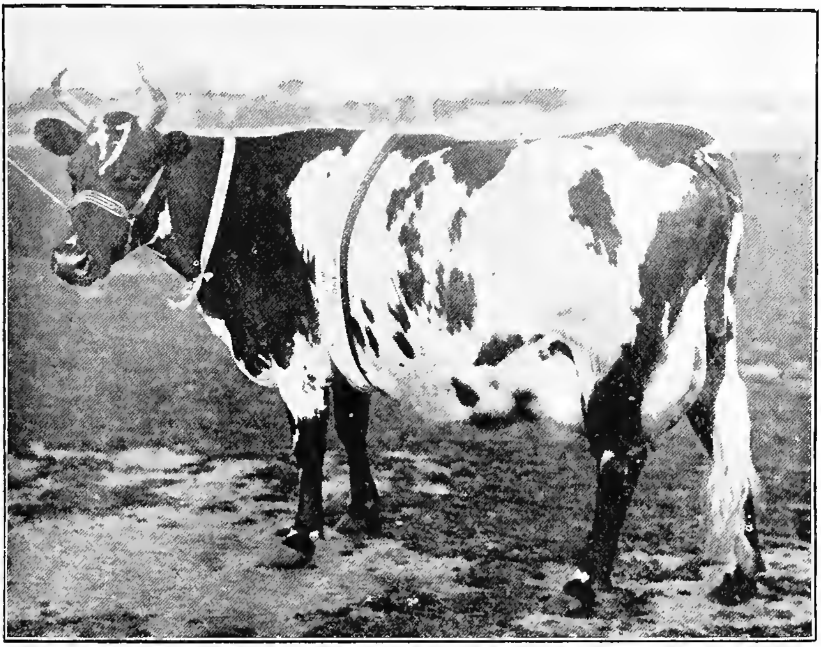
This unquestionably represents one of the best breeds for the production of milk, butter or cheese, and for the improvement of the farmer's herd. Ayrshires are, perhaps, more hardy and less dainty feeders than other British breeds, and deep and reliable milkers. They certainly hold some of the highest records for butter production in this country. Their greatest fault is short teats, but many of the leading breeders have practically eliminated that from their herds, and where it still exists it will have lost its claim to notice with the more general use of the milking machine, which can manipulate the short teats quite as well as the long.

The bull illustrated below is the famous "Jamie of Oakbank," who, I believe, has never been beaten in the show ring, and is the sire of a race of many first-class butter producers. He was bred by the Messrs. McNabb and Brothers, Oakbank, Tullamarine. The cow, "Ada of Glen Elgin," is from the splendid herd of Mr. T. A. Grant, Toolern.



AYRSHIRE BULL, "JAMIE OF OAKBANK."

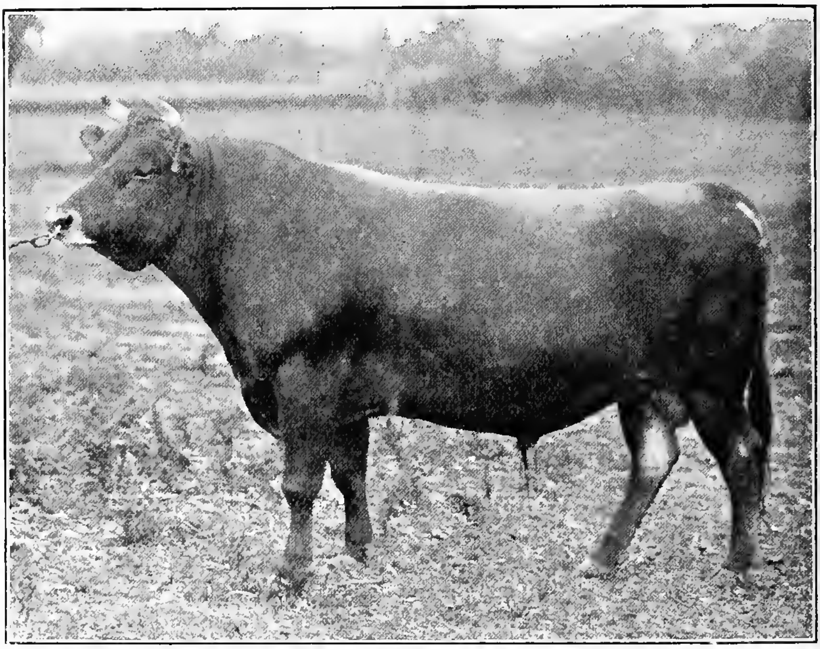
The favorite colour of the Ayrshire is a light brown or brown and white; some few are found black and white, and now and then even a pure white one is seen; but, so far as I have seen or heard, never roan-coloured. At one period an Ayrshire was hardly considered pure unless it had a black nose, but a white nose is not looked upon as any drawback to a cow at the present time. The appearance of black here and there indicates the presence of West Highland blood. Some people think if a cow shows a notch in each ear it is a sign of pure Ayrshire, but this is a mistake. It belongs, however, to some families, and is regularly transmitted. The udder is the chief point from which we can infer the milking qualities of a cow of any sort, and especially of an Ayrshire. It should in form be long from front to back, stretching well forward on the belly, broad behind, filling up well the space between the legs, but should not be too deep vertically—that is, hang too far down—space being obtained in it rather through length and breadth. The udder should not be too fleshy, but should milk out well. The large veins on the belly should be full and prominent, with a good, large cavity at the upper end of each. "The Ayrshire Herd Book Society" says the head short, forehead wide, nose fine between the muzzle and eyes, muzzle large, eyes full and lively, horns wide set on, inclining upwards. Neck moderately long and straight from the head to top of the shoulder, free from loose skin on the under side, fine at its junction with the head, and enlarging symmetrically towards the shoulders. Fore-quarters sloping, withers fine, chest sufficiently broad and deep to insure constitution, brisket and whole fore-quarters light, the cow gradually increasing in depth and width backwards. Back short and straight, spine well defined, especially at the shoulders; ribs short and arched, the body deep at the flanks, hind-quarters long, broad, and straight, hoop bones wide apart and not overlaid with fat, thighs deep and broad, tail long, slender, and set on level with the back; udder capacious and not fleshy, hinder part broad and firmly attached to the body, the sole nearly level, and extending well forward; milk veins about udder and abdomen well developed, teats 2-2½ inches in length, equal in thickness, the thickness being in proportion to the length, hanging perpendicularly, their distance apart at the sides should be about one-third the length of the vessel, and across to about one-half the width. Legs short in proportion to size, the bones fine, the joints firm, skin soft and elastic, and covered with soft, close, woolly hair. Colour red of any shade, brown or white, or a mixture of these, each colour being distinctly defined. Brindle or black and white is not in favour. Average live weight in full milk, about 10½ cwt.



AYRSHIRE COW, "ADA OF GLEN ELGIN."

Jerseys.

This breed has the reputation, and rightly so, of producing the richest milk, on an average, of any breed, and there is no cow which, under fair conditions, is more profitable for the production of butter or cheese. It has proved itself to be an economical producer when well selected, well fed, and well managed, and without these no breed will give satisfaction. Mr. James Long says, "The economical points of the Jersey are, briefly, its production of rich milk, rich waxy butter, and exceptionally rich cream and cheese; the adjective is applied advisedly, for, with the exception of the Guernsey, which closely approaches it, there is no variety of cattle in the world which produces either cream, milk, butter, or cheese either so high in colour or so rich in quality." The Jersey cow is docile and easily managed, while her pretty fawn-like appearance is also in her favour, and it will always be to the farmer's advantage to have some Jersey blood in his herd, as it will be the means of improving the average quality of the milk. As much as 900 lbs. of butter have been produced from a Jersey cow in 365 days, while in the cheese-making competition at the World's Fair, at Chicago, the following results were obtained:—



JERSEY BULL; "OPTICIAN."

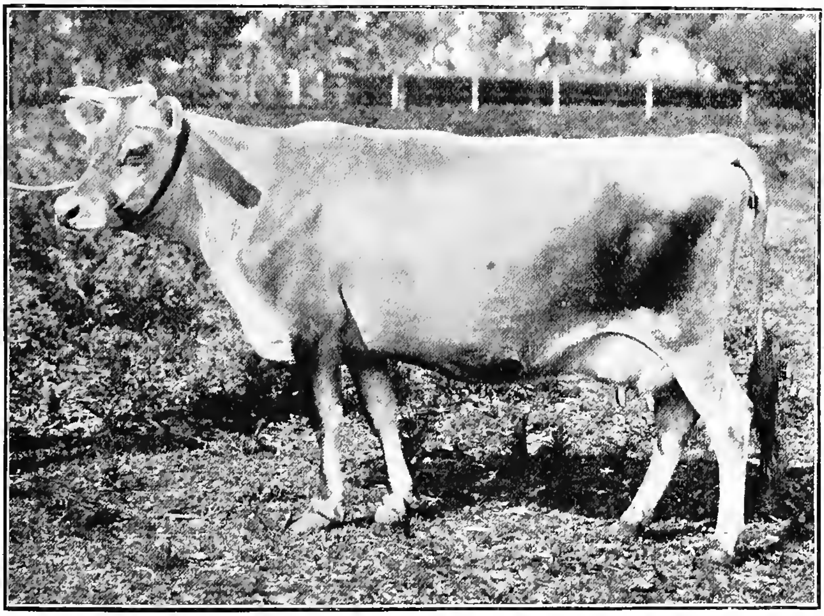
Twenty-five cows of each breed tested for fifteen days—

Jerseys	13,296·4 lbs.	1,451·76 lbs.
Guernseys	10,938·6 ,,	1,130·62 ,,
Shorthorns	12,186·7 ,,	1,077·6 ,,

The Jerseys are often held to be delicate cattle, but this is not the case when properly attended to. One thing applies to this, as well as to all breeds, namely, the only way to tell which are the best animals is by the use of the scales and the Babcock tester, and then to bear in mind that a good butter producer must be bred from good butter producers, or, in other words, " like begets like " applies here with perhaps greater force and certainty than in any other direction. The bull illustrated is " Optician," and the cow " Larkspur," both the property of the late Mr. James McCulloch.

The following is the description of the breed by the Royal Jersey Agricultural Society :—

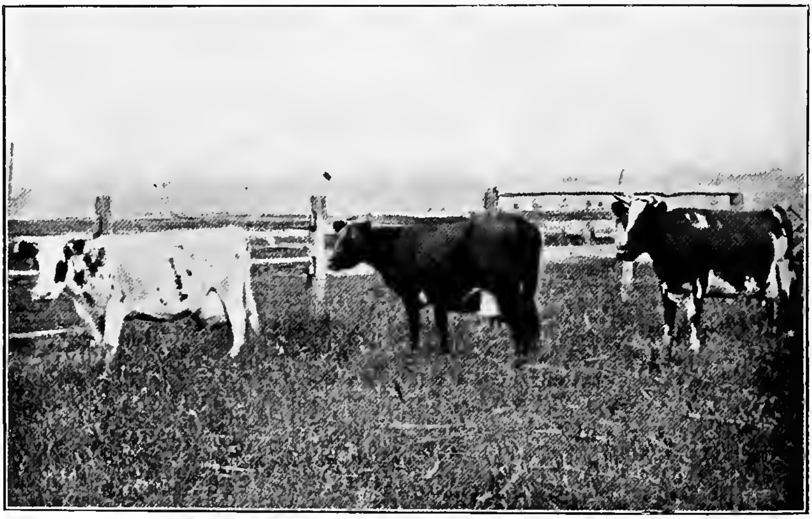
Head small, fine and tapering, cheek small, throat clean, muzzle dark and encircled by a light colour, with nostrils high and open. Horns small, not thick at base, crumpled, yellow, tipped with black. Ears small and thin, and of a deep orange colour within, eye full and placid, neck straight, fine, and lightly placed on the shoulders; withers fine, shoulders flat and sloping, chest broad and deep, being well ribbed up. Back straight from the withers to the setting on of the tail, broad across the loins, hips wide apart and fine in the bone, rump long, broad and level, tail fine, reaching the hock and hanging at right angles with the back, hide of a yellow colour, thin and mellow, covered with fine, soft hair. Legs short, straight and fine, with small hoofs, arms full and swelling above the knees. Hind quarters from the hock to point of rump, long, wide apart, and well filled up. Hind legs squarely placed when viewed from behind, and not to cross or sweep in walking. Udder large, not fleshy, running well forward in line with belly and well up behind. Teats moderately large and yellow, of equal size, wide apart, and squarely placed. Milk veins about the udder and abdomen prominent.



JERSEY COW, " LARKSPUR."

PROFITABLE DAIRYING.

One of the most pleasing features in connexion with the dairying industry, is the general improvement in the butter-producing capacity of our herds that is continually in progress, and has been evident for a number of years past, and the ever-increasing interest that is taken in the results of the milking competitions in connexion with the various agricultural shows. The lessons to be obtained from these are of a very far-reaching nature, and go a long way to prove to dairymen the necessity for testing their cows, keeping a record of their individual returns, and culling out those that are not profitable. It also proves that the appearance of a cow is not altogether a safe guide as to her value, as many animals, plain, if judged on points, often give better returns when it comes to butter results, than their more handsome sisters. But, still, nearly all the record-breakers are, to all appearances, typical dairy cows, and such is the case with those dealt with and illustrated in this article.



PRIZE DAIRY COWS, YARRAM SHOW, 1904.

In the *Journal* of January, 1904, I gave an account of the competition in connexion with the Camperdown Show, the results of which were magnificent, as for 23 cows tested the returns ranged from 20·14 lbs. to 11·87 lbs. of butter per week.

The cows illustrated were the winners at the Yarram Show, 21st November, 1904, and are all the property of Mr. B. Hobson, one of the leading dairy farmers of the district, who milks at two farms 130 and 170 cows respectively, the former at the homestead.

We will describe these three prize-winners in detail. No. 1 (left-hand cow in picture), Bonny Lass—pure Ayrshire, sire Adonis, pure Ayrshire; dam, Bonny Lass (49 A.H.B. of A.), calved 23rd August, 1904—gave 40½ lbs. milk, test 4·3, butter 1·94 lbs. The tests of only one morning's milk were taken, but to show that this was not merely a chance return, Bonny Lass gave, on the evening of the same day, 36 lbs. milk, and the following morning 43 lbs. with a 4·3 test.

The cow's yield was at the rate of 27 lbs. of butter per week. She was awarded first for butter, and third for weight of milk.

The second prize cow, Jean (right-hand cow in illustration), is by Adonis, out of a pure shorthorn cow. She was also second for weight of milk. Her return was 43½ lbs. of milk, test 3·8, butter 1·83, or at the rate of 25½ lbs. of butter per week.

The third prize for butter was awarded to Heather (middle cow in illustration), by Adonis, out of a pure Holstein cow· This cow also took first for weight of milk, and first for best dairy cow in the yard, judged by points. Calved 28th October, and gave 47 lbs. of milk, test 3·0 = 1·54 lbs. of butter, or 21½ lbs. butter per week.

Mr. Hobson tested four cows for ten days, from which the average daily yield of milk was 30 gallons, or 7½ gallons each. It was put through the separator by itself, and returned at the rate of 21 lbs. of butter per week each. At the same time, sixteen cows were giving over 18 lbs. of butter per week each.

For several days in November, 1903, 100 cows gave 360 gallons of milk a day, the test being 3·6.

For the month of November, 1903, according to the books of the Yarram Butter Factory, the average daily milk supply was 299 gallons, or practically 3 gallons per cow, by measure.

For the twelve months, January to December inclusive, the total milk supplied to the Yarram Butter Factory from this herd was 64,150 gallons, the total butter being 27,738 lbs., average test 3·9, average price paid 9d., total money paid, £992 7s· 3d.

In addition to this, £200 was cleared out of skim milk fed to pigs, and over 70 calves were reared.

When it is remembered that this herd contains the usual proportion of heifers, it will be seen that the results are such as any man may well be proud of. These good results, however, are by no means an isolated instance, for an examination of the full returns (given below) of the 68 cows, which were tested for the Yarram competition, it will be seen that there are many very good returns, and the average of the whole 68 works out at 1·02 lbs. of butter per cow for the morning's milking, or approximately at the rate of 14¼ lbs. of butter per week. They were all milked out dry at home, in the presence of stewards, at 6 p.m., and at 8 o'clock the following morning, or, after fourteen hours' interval, they were milked for the test. It must be admitted that milking the cows at home, where they are accustomed to the surroundings, is a very great advance, as compared to milking them on the show ground. The system will not be perfect until tests are made to cover two or three days. The importance of the subject should warrant the giving of large prizes, which would command correspondingly large entry fees, and should cover the cost of carrying out the tests.

One of the most important lessons to be drawn from the above is that of the value of a good bull, a bull that proves to be a getter of good butter-producers. This was never better illustrated than in the case of Mr. Hobson's cattle, as the majority of the best animals are by the bull Adonis.

Farmers generally are not careful enough in the choice of bulls. If they are of the breed they fancy, and have a long pedigree, they are satisfied. This is not enough, for unless they come of good butter-producers, they are no use to the man who is striving to improve his herd, and every one who is about to purchase a sire should first assure himself that the bull's ancestors have been good butter-producers.

It would be a great advantage to all connected with the dairying industry, if breeders would establish a register, have their cows officially tested, and their returns recorded. Any animals giving a certain number of pounds of butter per year would be eligible for registration.

Bulls from such animals would find ready sale at remunerative rates, and great good would accrue. This is done in many other countries, and I wonder our breeders have not moved in the matter. Some of them have taken up the work of systematically testing their cows, and it is to be hoped that a system of registration will follow.

There is another lesson to be learned from the above.

	£	s.	d.
The milk from 100 cows realized ...	992	7	3
Skim milk, fed to pigs	200	0	0
Seventy calves at £1	70	0	0
	1,262	7	3

or £12 12s. per head.

Allowing £2 10s. per cow for feed, and £1 10s. for labour, &c., or £4 per head in all, a profit is left of £8 12s. per cow.

The average production of butter per cow, 277 lbs., cost £4, less than 3½d. per lb. to produce.

When it is stated that butter can be produced in this favoured country for less than 3d. per lb., and what it realizes over that is profit, many producers do not hesitate to express their doubts, but we have many records to prove this, and the real value of these milking competitions is to increase the number of herds which are doing so.

Yarram Dairy Competition.

Name of Cow.	Owner.	Lb.	Test	Butter	Name of Cow.	Owner.	Lb.	Test	Butter
Pepper	J. McAninly	24½	3·7	1·00	—	J. Stephenson	19	3·6	·76
Primrose	,,	32	3	1·04	Red Rose	Rossiter Bros.	33½	3·4	1·33
Mayflower	J. J. McKenzie	25½	4·3	1·21	Honeycomb	G. E. Jeffs	28	2·8	·85
Pigeon	,,	20	3·5	·78	Butterfly	,,	25	3·6	1·
Tinney	,,	26	3·5	1·01	Tiny	,,	24	3·6	·96
Bonny Lass	B. Hobson	40½	4·3	1·94	Dolly	T. Wolfe	26	2·9	·81
Heather	,,	47	3	1·54	Prim	,,	24½	3·5	·97
Jean	,,	43½	3·8	1·83	Lady	,,	26½	4·1	1·20
Buffalo	J. B. Davis	28½	3·3	1·04	Edie	J. Asmus	28	3·5	1·08
Daisy	,,	23½	3·3	·86	Daisy	W. E. Bodman	29	3	·95
Creamy	,,	15	3·4	·56	Minnie	,,	30½	3	·99
Bluey	H. J. Alford	28	3·1	·95	Leopard	,,	31	3·7	1·26
Fairy	,,	30½	3·2	1·06	Lucy	T. Everett	33	2·5	·88
Dairymaid	,,	37	3	1·21	Fly	,,	23	4	1·02
Brassey	H. S. Hammet	25	4·4	1·18	Jersey	,,	22½	3·2	·78
Rose	,,	29½	4·3	1·40	Pansy	T. J. Wolfe	24	3·3	·87
Jewel	,,	26	4	1·15	Saucy	A. Macfarlane	23	3·7	·94
Pansy	Brain Bros.	30	3	·98	Brindle	,,	23	3·4	·86
Spot	,,	28½	3·2	·99	Poppet	,,	26	3·5	1·01
Duchess	,,	27	3·6	1·08	Trimmer	R. H. Jeffs	27½	3·6	1·10
Toby	B. Hobson	37½	3·4	1·40	Chrissy	,,	24	3·5	·95
Tiny	,,	27	4	1·20	Leopard	,,	20	3	·65
Toora	,,	28	3	·91	Ivy	D. T. McKenzie	25	3·3	·91
Cherry	F. A. Devonshire	24½	2·8	·74	Rose	,,	27½	3	·90
May	,,	26½	4	1·17	Poddy	Jas. McKenzie	30	3·2	1·05
Star	,,	22	3·6	·88	Curly	,,	26½	2·2	·92
Tiny	Lee Devonshire	28½	4·2	1·32	Frizzer	,,	33	3·5	1·27
Mousie	,,	23½	3·8	·99	Roan	T. G. McKenzie	16	3·5	·61
Mary	Jas. Rodgers	29	4	1·29	Spot	,,	26	3·2	·91
Buttercup	,,	29	3·6	1·15	—	W. H. McKenzie	24	3	·78
Darkey	Jas. Hagan	12	4	·52	—	,,	25	3·4	·94
Lady	,,	22½	4·2	1·03	—	S. C. Lowther	20½	4·4	1·00
Pet	,,	22½	2·8	·68	—	,,	22½	3·2	·78
Queenie	J. McAninly	28	3·7	1·15	—	,,	26¼	3·3	·95

THE PIG ON THE DAIRY FARM.

Very little has been said in the *Journal* of that most valuable of farm animals styled "the gintleman that pays the rint," and although his value is fully appreciated as being one of the principal adjuncts to the dairy farm, he does not meet with the kind and considerate treatment that he deserves, and which, when meted out to him, he will so readily respond to and repay.

The total value of pig products imported into Great Britain during 1904 was £20,952,083, of which Victoria has contributed practically *nil.* The total product of the pig in this State for the year 1904 was valued at £329,490, so that it will easily be seen what room there is for expansion in this important industry. The average price paid by Great Britain for pig products was 4¾d. per lb., viz.:—

Fresh pork	4.8d.
Salt pork	2.6d.
Bacon	5d.
Ham	5.6d.
Lard	3.9d.

The value of pork, ham, and bacon exported from this State for season 1903-04 is £32,681, the ham and bacon being valued at 6d. per lb.
The prices paid by Great Britain were:—

Hams—		
United States	5.35d.	per lb.
Canada	5.24d.	,,
Other countries	6d.	,,
Bacon—		
Denmark	5d.	,,
United States	4.74d.	,,
Canada	5d.	,,
Other countries	5.22d.	,,
Fresh pork—		
Holland	4.8d.	,,
Belgium	5.4d.	,,
United States	4.7d.	,,
Other countries	5.73d.	,,

The pigs of this country, being fed principally on separator milk and grain, their products will be quite equal to the best, and I hope to show that they can be produced as cheaply in this, so as to compete successfully with any country.

The pig, by nature, is one of the cleanest of animals, and in internal construction resembles the human being more closely than any other animal. What wonder then is it that we hear of so much disease when they are kept under such filthy conditions as we so often see. Give them clean healthy surroundings and we shall hear very little of disease, and they will be to us the money-making machines they have proved themselves in other countries.

One of the most valuable features of the pig is its remarkable fecundity or reproductiveness. A sow will bear six to twelve, and often more, young pigs at a litter, and can be worked so as to produce five litters in two years. Mr. Hamilton, of Glenormiston, has fourteen sows, which average nine young at a litter, and two litters a year, or eighteen pigs each per year. Value these at 10s. per head, and we have £9 per sow per annum, and for the fourteen sows £126. Mr. Carpenter, of Heyfield, in Gippsland, fed on 2 acres of lucerne, after a fortnight's spell, fourteen sows and twenty-five young pigs for a period of three months. At this rate it would take 8 acres to keep them for a year, and, presuming they would produce as many young, and of the same value as Mr. Hamilton's, that would be £126 for 8 acres, or £15 15s. per acre, without any other food, and very little labour. However, it is in connexion with dairying that the pig proves himself of the greatest value by converting the skim milk, buttermilk, and whey into meat of the highest quality.

SEPARATOR MILK.

On many of our dairy farms the value of the separator milk when fed to pigs amounts to £3 or £4 per cow. For instance, Mrs. Holliers' (Yarragon) returns were £4 per head for skim milk fed to calves and pigs. Mr. Jeffs' returns for pigs and calves were over £4 per cow. Mr. Hamilton's return from pigs for last year was £274, in addition to 90 calves sold as vealers at 10s. per head, amounting to £45. These results are not due to feeding on the most scientific principles for by following the lines laid down by repeated experiments conducted at the leading experimental stations in Europe and America, better results may be obtained. As in this country we have not the facilities for conducting tests as they have there, we may benefit by the results of those experiments.

At the Wisconsin Experiment Station, Professor Henry conducted nineteen trials with eighty-eight pigs of all ages, to determine the value of separator milk in combination with maize meal. The proportion of milk to meal varied from 1 lb. to 9 lbs. of milk for each pound of meal fed, and the following table clearly shows the results:—

SEPARATOR SKIM MILK AND MAIZE MEAL REQUIRED FOR 100 LBS. OF GAIN.

When Feeding.	No. of Trials.	Feed for 100 lbs. pork.	
		Meal.	Milk.
1 lb. corn meal to 1–3 lbs. skim milk ...	3	321	585
1 lb. ,, ,, 3–5 lbs. ,, ..	8	265	1,048
1 lb. ,, ,, 5–7 lbs. ,, ...	5	250	1,434
1 lb. ,, ,, 7–9 lbs. ,, ...	3	207	1,616

Assuming that 500 lbs. of maize meal fed alone would have produced 100 lbs. of pork (the average of a number of trials was 532), we find that with the first group 585 lbs. of skim milk effected a saving of 179 lbs. of maize meal. On this basis 327 lbs. skim milk is equal to 100 lbs. of maize meal when fed in the proportion of not exceeding 3 lbs. of milk with 1 lb. of meal. Taking maize meal as a standard, we find the values of skim milk, when fed with maize meal in the varying proportions, as follow:—

MEAL SAVED BY MILK FED IN VARYING PROPORTIONS.

When fed in proportion of –	lbs. Milk.	Saves lbs. Meal.
1 lb. maize meal to 1–3 lbs. separator milk ...	327	100
1 lb. ,, ,, 3–5 lbs. ,, ...	446	100
1 lb. ,, ,, 5–7 lbs. ,, ...	574	100
1 lb. ,, ,, 7–9 lbs ,, ...	552	100

Average of all:—475 lbs. skim milk equals 100 lbs. maize meal. This places a money value on separator skim milk. The following very interesting and valuable table shows at a glance the comparative value of separator milk when fed to pigs, combined with meal in different proportions and prices:—

Price of Maize.	Value of 100 lbs. skim Milk— When feeding – 1–3 lbs. milk to 1 lb. maize meal.		Value of 100 lbs. skim Milk— When feeding – 7–9 lbs. milk to 1 lb. maize meal.		Average of all Trials.	
	s.	d.	s.	d.	s	d.
1s. 2d. per bushel ...	0	7½	0	4½	0	5½
1s. 4¾d. ,, ...	0	9	0	5½	0	6½
1s. 7½d. ,, ...	0	10½	0	6½	0	7½
1s. 10½d. ,, ...	1	0	0	7½	0	8½
2s. 1½d. ,, ...	1	2	0	8	0	9½
2s. 4d. ,, ...	1	3½	0	9	0	10½
3s. 6d. ,, ...	1	11	1	1½	1	4

This table shows that when maize is worth 1s. 2d. per bushel, separator milk is worth, for pig feeding, 7½d. per 100 lbs., provided that not more than 3 lbs. of skim milk are fed with each pound of meal. If, however, 9 lbs. of milk be fed with each pound of meal, the milk is worth only 4½d. per 100 lbs., and the average value is 5½d. Another point should be borne in mind, that the value of the milk increases in proportion as does the price of meal. This shows the value of separator milk as compared with maize meal for producing pork or bacon. The Danes place the value at 6 lbs. skim milk equal to 1 lb. meal. Separator milk has a higher value than is apparent from the above, for feeding young pigs especially, as it is very rich in protein or nitrogenous matter, which is a producer of muscle and bone. This is from a practical stand-point, and if a study is made of Dr. Cherry's articles on the theory of feeding, the reasons will be evident.

BUTTER-MILK.

Butter-milk, provided no water is added, is practically of the same value for feeding pigs as separator milk. But it must be borne in mind that butter-milk from factories almost always has mixed with it a considerable amount of added water, sometimes as much as 50 per cent., and, consequently, by itself is not a suitable food for pigs. Many instances can be given of great mortality among pigs fed solely on butter-milk, practically from starvation, because they were not able to consume enough butter-milk plus water to derive sufficient nutriment to supply the demands of nature. But when the deficiency in solids is made up by adding meal, or even grass, roots, or other fodder, pigs are found to thrive on the butter-milk.

We have to remember that a pig requires about 2 lbs. of feed equal to pollard per day per 100 lbs. live weight, for the purpose of keeping up the system, that is, to keep up the temperature, repair the waste of tissue, &c., and that butter-milk contains 90 per cent. water and 10 per cent. solids. From the results of trials with some hundreds of pigs, it is found that animals of 50-100 lbs. live weight consume, on an average, 3.35 lbs. per day. Pigs of 100-150 lbs. live weight eat 4.79 lbs. per day, and those of 150-200 consume 5.91 lbs. per day.

It will be seen from this that it would be necessary in the latter case that they should consume 59 lbs., or practically 6 gallons of butter-milk for the same result, and should the butter-milk be diluted by half, as is often the case, it would require half as much again, or 9 gallons, to produce this result. Then, a pig weighing 200 lbs. live weight does not require more than from 2 to 3 lbs. of water for each pound of dry matter, and whatever water is consumed over the required quantity has to be heated to the body temperature at the expense of a portion of the food eaten. This partly accounts for the increase in the value of separator milk when the proportion of milk to meal is reduced, but practical experience also proves that water may be added to butter-milk or separator milk without destroying its value, provided meal or other solid food is added to it. Separator and butter-milk also produce meat of the highest quality, both as regards flavour and texture.

WHEY.

Whey has not nearly the feeding value that separator milk or butter-milk has, especially for young animals, nor will it produce as good quality bacon, unless food rich in protein be used in conjunction with it. This is due to the fact that only a small percentage of protein or nitrogenous matter remains in the whey, the bulk of it being removed in the form of curd. A high percentage of sugar, however, remains, and when mixed with food rich in protein, such as peas, beans, &c., is a valuable food, particularly as it is easily digested and there is no waste. Whey has been found to have a higher feeding value than turnips, pound for pound, when fed with meal. The Danes find 12 lbs. of whey equal to 1 lb. of barley meal, and so 2 lbs. of whey are equal to 1 lb. of separator milk. This is for whey from cheese made from skim milk. In this country it will have a higher value where new milk is used, as there is a higher percentage of fat left in, and also a slightly higher percentage of casein or curd, and for these reasons will correspond with that of America, where they found 785 lbs. of whey equal to 100 lbs. of grain. As 5 lbs. of maize meal produce 1 lb. of pork, 39¼ lbs., or 4 gallons of whey, will produce 1 lb. of pork, then 25 lbs. separator milk should produce 1 lb. of pork. With a herd averaging 5,000 lbs. of milk, after deducting 5 per cent. for butter, there are 4,750 lbs. to feed to pigs, which should produce 190 lbs. of pork. This, at 4d. per lb., equals £3 3s. per cow.

CHEESE-MAKING.

It is generally averred that Australians are not a cheese-eating community. This lack of interest by the general public to the importance of cheese as an article of diet could be impressed upon them more than it really is. Why such indifference exists is owing, no doubt, to such a large quantity of inferior stuff being on the market. The complaint of cheese connoisseurs is that they cannot obtain a bit of good Victorian cheese at a grocer's. There is no doubt but that we have some of the choicest possible cheese manufactured in the State. The question is where does all that good material go to? It may be that the good brands are exported to other States. It is rumoured, however, that much of our own manufacture of cheese is sold in Melbourne as New Zealand. If such is the case, and I believe that it is credible, it is quite evident that a libel is being imposed upon our own products, and New Zealand receives credit for what she did not produce. I do not mean to say that our sister colony does not produce good cheese, but I do say that there is produced in Victoria cheese equal to the very best New Zealand. There is no doubt, however, that there is a great deal of inferior cheese on the market. This is generally due to many persons embarking upon a trade that they know nothing of. These people, by their ignorance of the work, bring the industry generally into contempt. It is to be expected that these bad makers will remain, although experience and education may reduce their number. It is evident that if we want to win credit for our own products, and increase the consumption of cheese, we must do something practicable. Mere words will not do. There must be action.

Value of Butter and Cheese as Food.

It is well known that milk contains the different food nutrients in the best possible proportions for sustaining animal life. It has been calculated that if an adult were to live on a milk diet alone, eleven pints per diem would be required to be consumed in order to afford proper nourishment. Comparing it with such a food as lean beef, it may be said that 1 lb. of beef contains about the same quantity of actually nutritious materials as a quart of milk. There can be no doubt, however, that while milk is perhaps not suited to act as the sole food of the adult, it is one of the best and cheapest articles of diet we possess. It is one of the most convenient, useful, and inexpensive sources of albumenoids which we have.

Though, perhaps, unable to live on a milk diet alone, we can at least obtain its principal constituents in concentrated form. Butter and cheese, as far as heating power goes, stand at the head of all foods. Butter has twice as much heating power, weight for weight, as every other food, except pork and cream cheese, while skim milk cheese, so far as flesh-forming constituents are concerned, is the most concentrated of all the common foods.

Cheese varies very much in composition, sometimes it contains but a small proportion of fat, while in other cases the fat is the most abundant constituent. A good cheddar cheese contains about 30.33 per cent. of water. The casein is very variable in amount. In skimmed-milk cheeses it amounts to as much as 50 per cent., while in some of the soft cheeses it may be as low as 11-12 per cent. The following table will give readers an idea as to the ranges of variation in the constituents of cheese:—

Name of Cheese.	Water.	Casein.	Fat.	Sugar.	Ash.
Cheddar, 3 months ...	36·17	24·93	31·83	3·21	3·86
,, 6 ,, ...	31·17	26·31	33·68	4·91	3·93
Skim Milk	45·39	33·12	9·97	6·39	5·13
Cream Cheese ...	30·65	4.94	62·99	...	1·15
Stilton	30·53	28·85	35·39	...	3·82
Camembert	50·16	21·85	21·13	...	3·80
Gervais	52·94	11·80	29·75	2·58	2·93
Gruyere	34·87	25·87	28·91	...	3·84
Roquefort	31·20	27·63	33·16	...	6·01
Edam	36·28	24·06	30·26	...	4·90
Gouda	21·90	46·95	24·81	...	6·32
Limburg	34·5	13·00	41·9	7·0	3·6
Gorgonzola	44·04	28·06	29·84		3·87
Separated Skim ...	50·50	43·10	1·20	...	5·20

Roughly speaking, 1 lb. of good cheddar cheese is said to equal 3 lbs. of beef in nutrient value. Many people affirm that cheese is very indigestible. Certainly the new curdy stuff called cheese that is in demand at the present time cannot be otherwise. If, however, the cheese be properly matured, it is easily assimilated. In fact, many medical men are now recommending it as a cure for dyspepsia. I have also been informed that many dyspeptics have been cured by its use. When indigestion occurs through eating cheese, it is generally owing to the article being improperly made, or not sufficiently matured. It is quite certain that different kinds of cheeses are more easily digested than others. I can at least confidently affirm that what are known as "soft cheeses" will agree with the weakest digestive organs.

THE MAKING OF CHEDDAR CHEESE.

Before entering into the details connected with cheese-making, it is necessary to say a word about the acidity of the milk, leaving special methods of ripening to be dealt with later on. To know how far the lactic acid fermentation has developed before the process of manufacturing commences is an absolute necessity. Two very convenient tests can be applied for this purpose—the rennet and the acidimeter (or titration) tests.

THE RENNET TEST.

Take 4 ozs. of milk from the cheese vat; bring this to a temperature of 83 degs. F.; have a cup containing 1 drachm (60 minims) of rennet and a teaspoon, all at the same temperature as the milk; pour the milk into the cup, noting time on second hand of a watch or clock; stir rapidly for 5 secs.; allow it to settle 5 secs.; then insert the forefinger in an oblique position; raise it gently about every second, and immediately the milk thickens on the finger, note how long it took from the addition of the milk until coagulation occurred, which should be from 18 to 23 secs. The time varies a good deal on different farms, the time of the year, and the strength of the rennet. This test is a guide as to the state of ripeness: the riper the milk the fewer number of seconds in the test, and *vice versâ*. The maker must use his own judgment in regard to this. His object should be, if possible, to always have the milk at the same degree of ripeness, so that the whole process of manufacture, from renneting till salting of the curd, does not take less than five or more than six hours. If under five hours, the milk was overripe, and the maker should rennet a little sooner. If over the the six hours, allow more acid to develop the following day. In performing this test be sure that temperatures are correct, and before inserting the finger see that it is clean and dry.

ACIDIMETER OR TITRATION TEST.

The acidimeter or titration test is based on the fact that one cubic centimetre of decinormal solution of caustic soda will neutralize .009 grammes of lactic acid. To perform the test, put 10 c.cs. of the liquid to be tested in a white cup, and to it add 3 or 4 drops of phenolphthalein solution which acts as an indicator of the point that neutralization of the acid by the soda takes place by the production of a pink colouration. Fill a burette graded in one-tenth of c.c. with the soda solution, but not above the 0 mark. Note the point at which the solution in the burette stands; then turn the tap, and allow the solution to run gradually into the milk, stirring with a glass rod all the time. Each drop of the solution produces a pink colour, but when stirred it immediately disappears until the soda solution overpowers the acid, when a permanent pink colouration is produced. As soon as this point is reached, note how far the liquid has come down the burette; and if it has come down 22 spaces, the percentage of lactic acid is calculated as follows :— $\frac{22 \times \cdot009 \times 100}{10} = \cdot198$ the percentage of lactic acid present.

A quicker way of calculating is by multiplying the number of the c.cs. of the alkali used by 9, divide by 1-10th of the c.cs. of the milk taken finally, placing a decimal point in front of the result thus, $\frac{22 \times 9}{1} = \cdot198$ per cent. So as the working of this test will be more readily understood, I will detail the number of spaces on the burette that ought to be used in the different stages of cheesemaking.

Milk at renneting should show from 20 to 24 spaces, according to conditions.
Whey when curd is cut 14 or 15 spaces.
Top whey when curd is taken out of making vat 19 to 20 spaces.
Whey from press 100 to 110 spaces.
Milk that takes 25 to 26 spaces will be fast working.
,, ,, 27 to 28 ,, ,, very fast working.
,, ,, 30 to 32 ,, ought not to be made into cheese.

Whey, when curd is cut, taking 16 to 17 spaces, indicates that quicker "cooking" is required, and when showing 18 or 19 spaces curd must be cut very small and "cooked" rapidly. Great care should be taken that the burette is corked up immediately after use, and also that the bottles containing the different chemicals are not exposed to atmospheric influences any more than can possible be avoided. Mention has already been made regarding rennet and its action. It is most active at temperatures ranging from 82 degs. to 98 degs. F. Below or above these temperatures its action is retarded, and at 130 degs. F. it is destroyed altogether. We have many brands of rennet on the market, each maker claiming that his is superior to all others. Many of them are good, but a few bad. There is, however, a tendency amongst them all to vary in strength, and when a cheesemaker opens a fresh bottle he ought to compare the strength with some of the lot he had been previously using. This is easily arrived at in the following manner:—We will assume that the rennet in previous use was A's, and the fresh supply B's. Take two litres of milk at 95 degs. F., and place in separate basins, to one of them add 1 c.c. of A's, and to the other the same amount of B's rennet at exactly the same moment. Maintain the temperatures of the milk at the 95 degs. F., and note the time that each one takes to coagulate. If A's takes, say, 3 min. 20 secs., and B's 4 min. 10 secs. to bring about coagulation, then A's rennet is fully 1-5th times as strong again as B's. If then the cheesemaker has been using 4 ozs. of A's lot to every 100 gallons of milk, it follows that he will have to add 5 ozs. of B's rennet to bring about coagulation in the same period of time. Great care should be taken that not too much or too little rennet is added. If too much is used, the result is that the whey is expelled too quickly, the curd is too firm, and the cheese is more likely to be dry and crumbly. On the other hand, when too little rennet is used the whey is not expelled fast enough, the acidity thereby getting ahead of the work more readily, the coagulum is weak, resulting in loss of valuable material. When a proper quantity of rennet is added the whey is clear, and coagulation is produced in from 40 to 45 minutes, when there is about 2 per cent. of lactic acid present, and the temperature of the milk about 83 degs. to 86 degs. F. The amount of rennet to add varies, according to the strength, local conditions, and quality of the milk, rich requiring rather more than poor milk, as it is more difficult for the casein to enclose the fat in such a case. From 3 ozs. to 4 ozs. to every 100 gallons of milk may be taken as an average quantity to add.

PRACTICAL CHEESEMAKING.

I have given sufficient regarding the principles of cheesemaking for the ordinary practical cheesemaker, and will now give a thorough outline of its practice, giving reasons for doing certain things at different stages.

The man who wishes to go in for cheesemaking in a proper manner ought to have a proper up-to-date plant, which consists of—

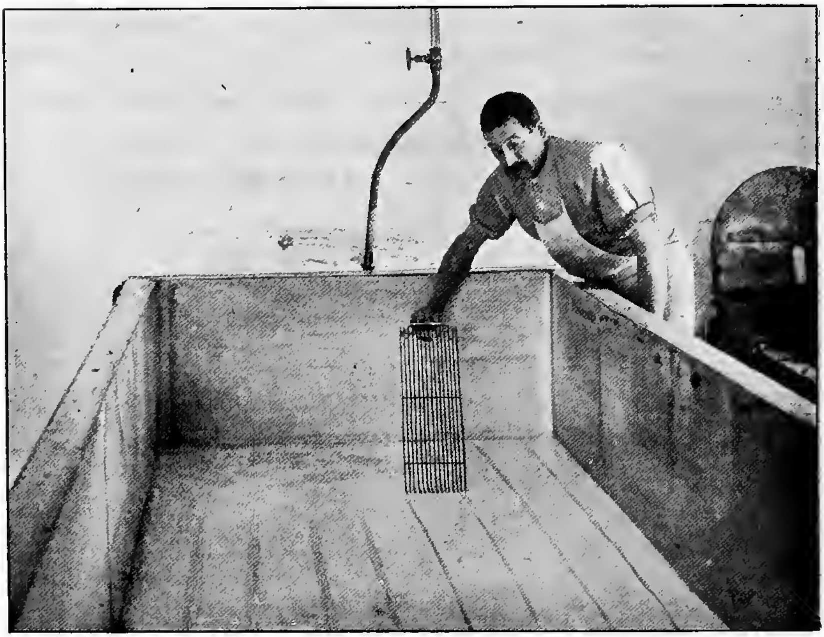
American double-jacketed making vat, with steam fittings.
Milk cooler.
Gang press, with spring heads or lever presses.
Set of best American curd knives.
Fergusson curd mill.
Acidimeter outfit, thermometers, measures, &c.

If he can afford it, a steam boiler as well, if not, he should have a water pipe leading to the vat from an ordinary copper.

Stage 1.—The work of cheddar cheesemaking practically commences in the evening. The milk when drawn from the cow should be well strained, and taken immediately from the cow yard into a purer atmosphere. It should be cooled down either by emptying it direct into the making vat, and running cold water around the vat; it can also be placed in shallow pans, or run over an ordinary cooler into the making vat. The latter plan is perhaps the best, particularly when the milk is inclined to be gassy, because when it is running in thin layers the gases are partly expelled: this is known as "aeration." It is not advisable to cool the milk below 65 degs. to 70 degs. F., as there is a danger of the lactic germs being checked too much, and encouragement given to certain undesirable ferments, which can work at low temperatures. During the evening the milk should be occasionally stirred, thereby preventing too much cream arising.

Stage 2.—In the morning the cheesemaker should note the temperature of the dairy, and the condition of the milk. The cream should be skimmed off and heated to about 90 degs. F., and mixed with three to four times its bulk of warm morning's milk, and then added to the vat. Treating the cream in this way allows it to be more thorough distributed throughout the milk. The evening's milk, if it be too acid, should be rejected; and in case it be well advanced the maker must make certain alterations to suit the conditions. If, however, it is in good condition, it should not be heated up until all the morning's supply has been added. When the two milkings are mixed together, it should be heated up to the temperature desired for renneting as quickly as possible. Temperatures for settling vary from 82 deg. to 86 deg. F., the lower temperature being adopted in warm weather and the higher in cold. When the renneting temperature has been reached the starter should be added at the rate of $\frac{3}{4}$ to 1 per cent., enough to bring about proper ripeness of the milk in 40 to 50 minutes. Before adding to the milk, the top of the starter should be skimmed off and thrown away, and what is required for inoculating a quantity of prepared milk for the next day kept back from about the centre of the starter. Mix what you are going to use with a little pure cold water; stir it to break up any lumps, and then strain through a muslin cloth into the milk. The starter must be well stirred through the milk for a couple of minutes. Subsequently, and at intervals during the time that the milk is acquiring condition, the rennet and titration tests should be frequently tried, and when the proper degree of ripeness has been attained no time should be lost in getting the rennet added. At least five minutes previous to renneting the colour should be added, the amount varying from 1 oz. to 2 ozs. to every 100 gallons. As to the exact amount the maker must be guided by the trade demands of his product, some buyers requiring more or less highly coloured cheese than others. Very high colouring should, however, be avoided, as there is more danger of discolouration when large quantities are used. The colour should be mixed with five to ten times its bulk of pure cold water, and should be well stirred in the milk for two or three minutes. By mixing with water it is more easy to get the "Annatto" incorporated with the milk.

Stage 3.—Renneting.—Just before adding the rennet it is a good plan to run a muslin cloth along the surface of the milk, in something the same way as a fisherman uses a net, only the cloth requires to be not more than 4 inches under the surface. This idea was shown to me some time ago, and it answers admirably for getting off any specks of dust or fat that may be floating on the surface. The rennet is measured out, and mixed with at least ten times its bulk of cold water, and then stirred into the milk for from three to six minutes. When the milk is likely to "work fast," the shorter the period of stirring, and *vice versâ*. The time of renneting should be noted. The idea of diluting the rennet is that when strong rennet is added to milk there is a danger of that which it first comes in contact with being coagulated, thus rendering an uneven coagulum. With dilution, however, this danger is avoided. About three to five minutes after the rennet has been stirred in, the period depending on the milk whether fast or slow, the surface of the milk should be ruffled with the fingers. This helps to keep the cream from rising, and the vat is then covered up. The time that the rennet takes to act should be noted. This is done by inserting the finger into the milk in the same manner as in the cup test, and when the milk begins to thicken it is known as the "catching" point. This should take about 12 or 13 minutes, and by adding two and a half times the number of minutes that the rennet took to act on to it, the exact number of minutes—the time that the curd will be ready to cut—can be fairly accurately arrived at. Thus we will suppose that it took 12 minutes to thicken: two and a half times 12 is 30,, add 30 on to 12, and we have 42 minutes.

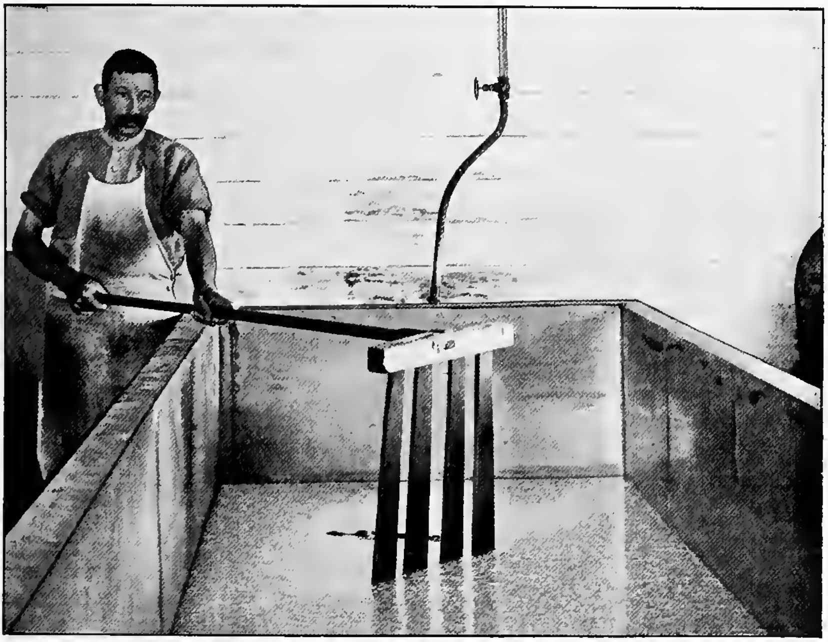


CUTTING THE CURD WITH PERPENDICULAR KNIFE.

Some makers take this as a guide as to how quickly the curd will work. Thus, supposing it thickened in six minutes, they would conclude the milk was over-ripe. I have, however, come across instances where this method was unreliable. A difference of a degree or two of temperature at renneting one day from another causes a difference in the time of "catching." We will take the milk of two days, and knowing that the rennet and titration tests are the same each day, the rennet being added at 83 deg. F. one day and 86 deg. F. the following day, naturally that milk which was renneted at the higher temperature thickens, perhaps, two or three minutes quicker than the previous day's; yet we know that the percentage of acid was the same. An instance of this was brought before my notice the other day. A cheesemaker came to me, and said that the milk thickened in one minute and a quarter, and yet it took nearly three hours before the curd was fit to salt. I said there must be something wrong somewhere. I tested his thermometer. It showed 91 deg., when it should only have registered 84 deg., thus being 7 deg. out; and there the most of the trouble lay, although the milk had certainly been over-ripe. I should certainly not advise any maker to be guided by this rule as to the working of his curd, but by the rennet and acidimeter tests, and his own experience and common sense.

A good plan to know when curd is ready to cut is to insert the forefinger immediately under and along the surface of the curd, and by using the thumb in the same way as a coulter acts on a plough, a clean break is made over the forefinger. The curd should also have a velvety appearance, and an elastic resistance when back of hand is laid on it.

Stage 4.—*Cutting.*—Cutting is done by means of so-called American knives, which are really several rows of steel blades, separated from one another by about a quarter of an inch. There are two of these knives—one with the blades set vertically, and in the other horizontally. The object of cutting is to reduce the curd to pieces of a size that can be easily "cooked," and to facilitate the removal of the whey. Great care should be taken that the cubes are cut as near a uniform size as possible. Should the size be unequal, the small ones get cooked much quicker than the large; and, in many cases, the large cubes do not get cooked at all. The result is that these uncooked particles may produce gases in the manufactured cheese, and also aid to destroy the keeping qualities. It is immaterial which knife is used first, but I find that by using the horizontal first the curd is not so liable to run before the knives. This knife should be inserted into the coagulum on the flat as much as possible, so as to avoid unnecessary crushing of the curd; run it down the



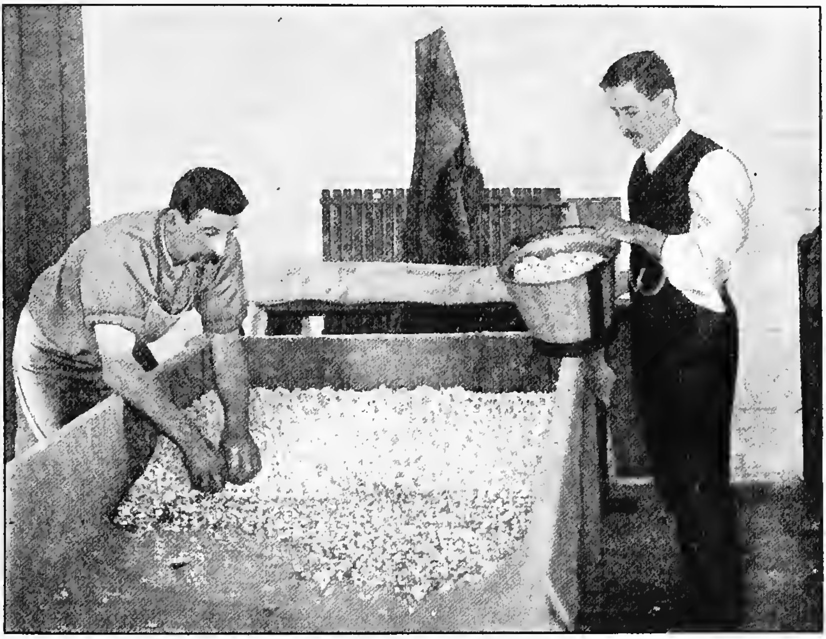
THE COOKING PROCESS OF CHEDDAR CHEESEMAKING. STIRRING WITH THE RAKE.

vat lengthways, and turn it without lifting it out; and avoid going over the old track as much as possible. The knife should be lifted out as carefully as it was put in. The next step is to use the vertical knife lengthways. This is done in a sort of jerking, forward movement. To put it plainly: for every 2 inches the knife goes forward, it should come one back. This knife should be lifted out at the end of each cut, and great care should be taken to avoid the curd running before it. A little practice, however, soon makes one proficient at this point of the process, as it is altogether mechanical. After cutting lengthways with the vertical, the curd is then cut crossways with the same knife. The operator stands on one side, and reaches over the other side of the vat with the knife, drawing it quickly to him, and lifting the knife out at each stroke, until the process is finished, which should not take more than ten minutes altogether from the commencement of cutting. If the curd is cut before it is firm enough, there is a loss of valuable constituents, and the whey runs white. If it is allowed to become too firm it runs before the knives, and gets bruised, resulting in further loss; and it is also more difficult to get rid of in the later stages of manufacture. Should the whey rise rapidly, the curd is likely to "work fast," but should it be some time in doing so the working will be slower.

Stage 5.—When cutting is finished, stirring of the curd should be started first with the hands. The sides of the vat should be freed from curd, by gently rubbing it off. Both arms should be inserted in the vat, and the curd stirred very gently, bringing it from the bottom to the top, any large pieces that may have escaped the knives being broken up. The object of stirring with the hands instead of the rake at first is, that the curd can be more gently treated; rough usage causes the cubes of curd to be broken up, thereby entailing loss. Whilst this stirring is proceeding, a membrane is forming around the cubes, which allows moisture, but not fat, to escape.

After stirring with the hands about ten minutes, the heating process should be commenced, by either allowing steam or hot water to go into the double jacket, stirring with the hands being still continued for ten minutes, when the rake can be used. The scalding or cooking should be completed in from 40 to 45 minutes, raising the temperature about a degree every three minutes. The process should be slower at the beginning than towards the end. If cooking is done too rapidly at the first, a coat is formed on the outside of the curd, and the whey cannot escape, thereby spoiling the cheese to a great extent. The temperature to which the curd should be cooked varies, according to conditions. If the milk be produced from limestone soils, about 97 deg. to 99 deg. F., from a gravel soil, 98 deg. to 102 deg., and from a clay soil higher. The reason for employing higher temperatures in the two latter cases is that the moisture is more difficult to expel. Milk rich in fat requires a higher degree of temperature at this stage than poor, because the extra fat aids in the retention of the whey. When milk is rich in fat it generally takes from 100 deg. to 102 deg. F. to cook the curd properly, and when of medium quality 98 deg. to 100 deg. F. will usually suffice. Fast curd requires to be heated as high as 105 deg. to 106 deg. F.

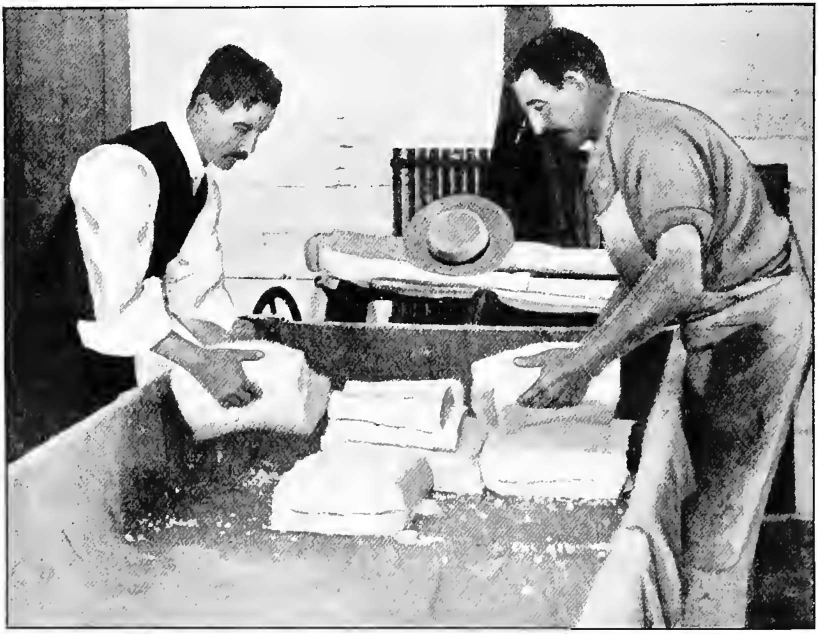
When the heat is within 1 to 2 degs. of the temperature that is desired in cooking, the steam or hot water should be turned off, as the water in the jacket will generally raise it sufficiently to the desired heat. The water in the jacket ought also to be run off as quickly as possible at this stage. If it is not, when the curd is allowed to settle in the whey, it is liable to get scorched, by immediate contact with the warm bottom of the vat. Stirring should be continued for about 10 to 20 minutes after the cooking point is reached, so as to firm the curd. The object of stirring is to aid in the removal of the whey, to allow more equal development of acid, and also to insure equal cooking. Before allowing to settle in the whey the curd should have a firm feel, that when a portion of it is squeezed in the hand it falls into its original particles when ruffled. When this condition is acquired the curd should be allowed to "pitch," and should lie in this state from 45 to 60 minutes. At this stage it should not be disturbed any more than can possibly be avoided. It should, however, be frequently tested for acidity by means of the "hot iron test."



THE CURD BEING LIFTED FROM THE MAKING VAT INTO THE COOLER.

This test consists in heating a piece of ordinary shoeing iron, about 18 inches long, to black heat, and by taking a piece of curd after squeezing it as dry as possible, touch one corner of the piece on the iron, and should it go brown immediately, then it is the proper heat. Hold the curd tightly between the finger and thumb, rub it several times on the iron, and then draw gently away when, if the curd is sufficiently acid, fine silky threads will attenuate to about $\frac{1}{4}$ inch long, if too acid it will attenuate to a greater length, and if not sufficiently acid will not attenuate so far. The testing iron should always be clean and free from grease, the curd perfectly dry, and the test should not be performed in a draughty place, or the threads are liable to break off too short. Another guide as to when sufficient acidity has developed is to hold a handful of the curd downwards, when it should hang similar to a bunch of grapes, it should have left the sides of the vat, and where a piece of curd is rubbed on the teeth it should produce a squeaking sound. When the curd has attained this condition the whey should be run off as quickly as possible. Should it be left too long at this stage the cheese will acquire a bitter flavour.

Stage 6.—Immediately the whey is drawn the curd should be lifted into a cooler, which has a false slatted bottom, covered with a fairly open cloth, and well stirred for from 5 to 8 minutes, breaking up all lumps, but not bruising the particles of curd unnecessarily. Should the curd be soft, it is stirred longer than if it were firm, as by stirring a soft curd it is firmed up a good deal. The object in stirring is to aerate the curd, and to expel unnecessary whey. When to the satisfaction of the maker stirring is sufficient the curd is then piled at one end of the cooler to a depth of 4 inches to 5 inches. The surface should be made quite level, and then the whole covered over to maintain the heat. Lying in this state, and the processes until milling are distinctive of the Cheddar process. After the curd has been piled about 15 to 30 minutes, according to the rapidity that acidity is developing, the sooner if "fast," it is cut up into even-sized blocks, about 6 inches to 8 inches square, and turned over so that the part that was uppermost comes in contact with the bottom of the cooler. The blocks are piled on the top of one another two deep. This turning is done every 20 to 30 minutes, until the curd is ready for milling, "double piling" each time. Great care should be taken that the faces of the blocks that were most subjected to the atmosphere be placed inside at every turning, so as to maintain the temperature of the curd as



PILING THE CURD.

evenly throughout the mass as possible. The acidity also develops more uniformly throughout when this is done. It is also important to keep the curd well covered up, and not to allow the acid to be checked.

Stage 7.—In about one and a half to two hours from the time the curd has been piled in the cooler it should be ready for the milling process. To know when it is sufficiently matured, cut a small square piece of curd from the centre of the mass, and test it on the hot iron, when it should draw fine threads 1 inch to 1½ inches in length. It should also tear stringy, similar to the breast of a chicken, smell distinctly acid, show large gas cells when cut through, and have brown spots appearing on the outside of the curd. At this stage the lumps of curd should be weighed to ascertain the amount of salt required. Milling then should be done as quickly as possible. The object in milling is to cut the curd up into pieces, so that salt can be more readily incorporated and allow pressing the cheese more easily into a solid mass. After the curd is milled, it is stirred with the hand for about five to ten minutes. It is then spread over the bottom of the cooler and allowed to lie for 20 to 30 minutes. Stirring after milling is done to aerate the curd, and the reasons for allowing to lie for 20 minutes or so is that a further maturing of the curd takes place, during which it takes on a peculiar nutty flavour, and the particles of casein begin to break down, so that the fat may be removed by pressure. When this stage is reached the curd is ready for the next step, which is salting.

Stage 8.—Salt is added to check acidity, and to impart a saline flavour to the cheese. The salt makes the curd drier by reason of extracting the water for its own solution; therefore the reader should note that when a curd is wet or soft a little more salt should be added. The amount of salt to add is about 2 per cent., or about 1 oz. to every 3 lbs. of curd. The temperature at salting should not be above 80 deg. F. if possible, nor below 78. A salt of rather a coarse grain should be used, as it requires a somewhat longer time for solution, and the particles are carried to the centre of the pieces of curd more effectually. The salt should be well stirred through the curd for about five minutes; the curd should then be spread over the cooler, and left lie for about ten minutes. This allows the curd to cool and the salt to dissolve. After this the curd is again stirred up for a few minutes, and then it is ready for the next step, which is pressing. The object of pressing the cheese is to bring it into a form suitable for transportation, and convenient for consumption. The pressure also removes the surplus whey that is held by capillarity between the particles of curd. Moisture that may be inside the particles at this stage cannot be removed, and curd that is wet is because proper care was not taken to expel the moisture in the cooking process. The temperature of hooping should be from 75 deg. to 78 deg. F. Should it be too high, fat is liable to be lost in the press. On the other hand if it be too cold, the particles do not go together properly, thus a short-cutting cheese. The curd is filled into "hoops or vats," lined with special cloth for the purpose and should be weighed in equal quantities, so as to have the cheeses a uniform size. When the vats are all full the lids are put on, and then transferred to the press. Pressure should be applied very gently at first. If applied rapidly a coating is formed on the outside of the cheese, and the whey cannot escape from the inside. The press should be tightened just until the whey begins to come, and tightened up occasionally, or as soon as screw becomes loose, for about half an hour, when a fair pressure can be put on. On the other hand, the pressing must not be too slow, or else the curd is liable to get too cold on the outside of the cheese, and they cannot be brought together well afterwards. Whey tested from the press a few minutes after pressure is applied should take about 10 to 11 c.c.'s of the alkali to neutralize the acid showing an acidity of from .9 per cent. to 1 per cent. After the cheeses have been in the press about three-quarters to one hour they should be taken out and trimmed, the cloths being pulled up so as to have no wrinkles on the sides. Care, however, must be taken that in doing so about 1½ inches of the bandage are overlapping on the ends. Round cloths or caps should then be put on each end by sticking them on with scalding water. The vats are again transferred to the press, and full pressure should be applied at least in from three to four hours after the curd was hooped. The press should be screwed up occasionally during the evening. Small cheeses, up to 30 lbs., require only about 20 hours' pressing, but for larger sizes it is desirable to give them at least 40 hours, if possible. The morning after making, the vats containing the cheese should be dipped in water at a temperature of 135 deg. to 140 deg. F. for about 1 to 2 minutes. This gives a toughness to the skin of the cheese, rendering it less liable to crack. After dipping, the cheese should be put into the press again for at least a couple of hours, full pressing being applied. The cheeses, when taken out of the hoops, should be dated, and taken direct to the ripening room, and placed on the shelves. The shelves should be quite level and free from warping. Should they be out of shape in any way the result is that the cheeses soon become unshapely when placed thereon. The cheeses are turned every day for at least the first six weeks, and larger sizes are all the better to be turned daily for at least two months. After the lapse of this time alternate day's turnings should suffice. Turning is done to keep the cheese in shape, and to allow an equal evaporation. The temperature of the cheese room should be from 55 deg. to 60 deg. F. If the temperature be too low the cheeses are apt to develop bitterness, and if too high the cheeses lose fat, become dry and decompose. In the ripening room the cheeses undergo various fermentations, which as yet are not fully understood; but it is supposed to be due, to a great extent, to the action of the lactic germs, in the first stages at least. Whatever may be the cause, the cheese takes on its particular flavour at this stage; and no matter how well it has been manufactured, neglect in the ripening room will spoil a good cheese. Cheeses made on the aforementioned method will ripen in about four to five months, when they should have a "nutty flavour," cut solid, firm, and have a mellow feel when a piece is crushed between the finger and thumb, and be of uniform colour throughout. The rind should be smooth, without cracks, hard, and transparent. The ends of the cheese should be nearly parallel and the sides straight.

TREATMENT OF "FAST MILK."

The aim of the cheesemaker in such a case is to retard the acid as much as possible. The milk should be heated to 2 deg. below normal renneting. A little more rennet should be added. The curd should be cut rather sooner than when the milk is in good condition, and very fine cutting is necessary, so as the moisture can be more easily expelled. After cutting is finished, rub down the sides of the vat, and apply scald as quickly as possible. Get the desired heat up in about 30 minutes. The scald should go as high as 105 deg. F. to 106 deg. F. in such cases. If in the opinion of the maker the curd will not be firm enough before acidity has developed sufficiently he should run some of the whey off. This checks the acid slightly. When the curd shows about one-eighth of an inch of threads on the hot iron the whey should be immediately drawn off, the curd then lifted into the cooler, and well stirred. When the curd is very much over-acid it is a good plan to wash it with water that has been boiled and cooled down to the same temperature as the curd was heated to. The added water must be well stirred out, and then the curd is allowed to mat in a shallow layer. Cut into small blocks in about 10 minutes, and pile lightly, turning and piling every fifteen minutes until the curd is ready to mill, which should be done when threads show about ¾ inch long, about ½ per cent. more salt should be added. When sour curd is washed there is a loss of fat, but the flavour is improved thereby.

GASSY MILK.

When milk is observed to be gassy or bad smelling, allow more acid to develop before renneting. The whey should be drawn when the curd draws over one quarter of an inch threads on the hot iron. Milling can be done a little earlier, and then stir well, and allow curd to lie at least half an hour before salting.

CHEESE FAULTS.

Discolouration is caused by certain bacteria acting upon the colouring matter in the cheese. Moist curd and insufficient acid favour the fault. Too much acid in the curd before whey is drawn causes bleaching, as also does neglect to turn the curd sufficiently in the cooler.

Weak, pasty cheese follows quick scalding of rich milk, locking in the moisture. Remedy.—Rennet at higher temperature, heat slower, and scald to a higher temperature. Cutting can be done finer in the warm months of the year. The curd should not be allowed to become cold in the vat or cooler; this checks the acid, and prevents an escape of the moisture. A weak cheese when tried gives a swollen plug that cannot be replaced.

Cause of Cheese Cracking.—Too hard scalding, and too much acidity.

Open Bodied Weak Cheese.—The curd not being sufficiently firm when whey is drawn, *i.e.*, it has been allowed to settle in the whey before it is sufficiently stirred. Piling the curd too high encourages fast ripening, and a weak body in the product.

Soapy Cheese.—Too little acid.

Cheese leaking on the shelves is caused by allowing too much acidity to develop in the curd before it has been sufficiently cooked. In overripe milk this will happen, unless the alterations I have already mentioned are made in the process of manufacture. Acid milk or curd also makes cheese of a dry and mealy texture.

Loss of fat in curd follows a weak curd. a too wet curd, and pressing at too high a temperature, and pressure being applied too rapidly.

Bitter Cheese.—Curd too long in the whey, sudden fall in temperature in cooler, check in ripening room.

Cheese heaving in ripening room, due to curd not being sufficiently cooked, and too sweet.

Dry Crumbly Cheese.—Too much rennet, excess of acid and salt, cold curd and insufficient pressure, and too high a temperature at renneting.

Tainted Curd.—Impurities in the milk are generally the foundations of most taints, and which develop during the cooking process. Great care should be taken that no milk is used from a newly-calved cow, until she has been in at least five to six days, or until the milk will stand boiling without thickening. The remedy for bad flavours is to find the source if possible, and remove same. The use of a starter, however, aids, to a great extent, to overcome bad taints.

CHART FOR CHEESEMAKERS.

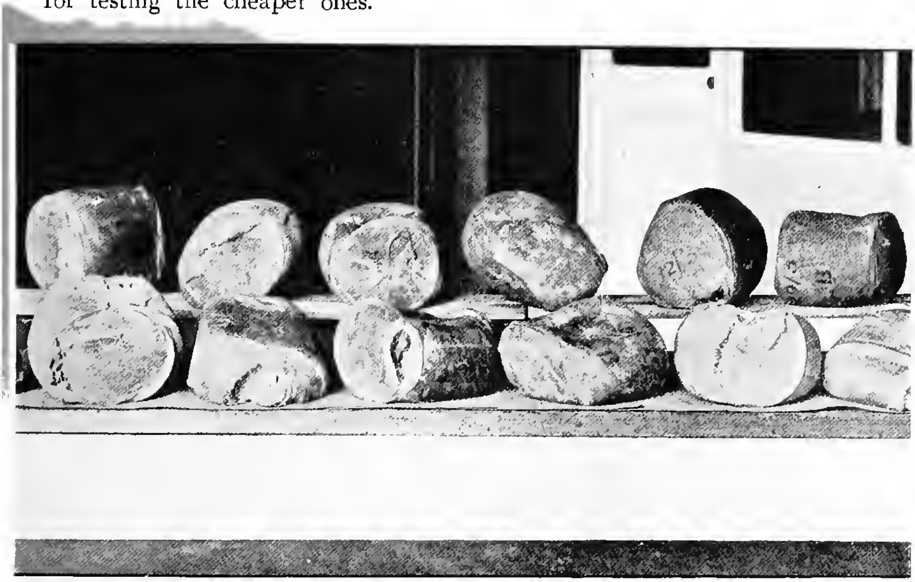
	Date.
	Temperature of dairy.
	Temperature of evening's milk in morning.
	Temperature of culture in the morning.
	Acidity of culture.
	Amount of culture added to vat.
	Gallons of milk
	Time from addition of culture until renneting.
	Amount of colour.
	Rennet test in seconds.
	Acidity test at renneting.
	Time of renneting.
	Temperature at renneting.
	Time of renneting.
	Time to catch.
	Time to coagulate.
	Started cutting.
	Finished cutting.
	Acidity of whey when curd cut.
	Started cooking.
	Finished cooking.
	Settled in whey.
	Temperature of cooking.
	Whey drawn.
	Acid in top whey at drawing.
	Acid in bottom whey at drawing.
	Time curd was lying in whey.
	Curd packed in cooler.
	Acidity of whey before milling.
	Milling finished.
	Salt added.
	Temperature at salting.
	Time of hooping.
	Temperature at hooping.
	Pressure applied at.
	Acidity of whey from press.
	Weight of green curd.
	No. of large cheese.
	No. of small cheese.
	Time from renneting to salting.
	Remarks.

Causes of Whey Running White or Milky.—Milk too sweet at renneting, weak rennet, too low or too high a temperature at renneting, cutting the curd when too soft or too firm, stirring roughly, delay in beginning to scald after cutting, entail loss of solids.

SUGGESTIONS.

The cheesemaker should do his utmost to make his cheese attractive by proper bandaging, and end cloths being put on neatly. The appearance of a cheese outwardly goes a long way with buyers, and it is also a guide as to whether a man takes an interest in his work or not.

I would also point out the necessity of having reliable thermometers. We have a lot of cheap rubbish on the market that is most unsuitable. For about 5s. a thoroughly reliable one can be obtained which can be used for testing the cheaper ones.



RESULT OF FORWARDING CHEESE IN BAGS.

I further point out how necessary it is for the managers of cheese factories to keep a chart of each day's work—a copy of which I give. The work entailed in doing so is very slight, and it well repays for the small amount of trouble taken. By it, when a cheesemaker has some particularly good article, he can look back and see how it was manufactured. On the other hand, should a cheese be bad, he can also see where the defects have occurred, and remedy same in future.

In the forwarding of cheese to market, care should be taken that they are transported in a proper manner. Sending cheese in a loose state, is a very bad method indeed. In some cases they have arrived at their destination in a quite unsaleable condition. The accompanying plate illustrates how some arrived, some time ago, at an agent's rooms in Melbourne. I strongly advise dairymen to get a few cases made for the purpose of packing cheese in, which can be returned when empty and used several times from the local market at least; by doing so they will very soon save the price of the cases.

STARTERS IN CHEDDAR CHEESE-MAKING.

When the cold weather has set in the cheesemaker is much troubled by slow working of the milk. He does not commence duties as early as in spring or summer, so if he has not some means at his disposal whereby he can be aided in the shortening of his labours, the curd is almost certain to be vatted before it is properly matured. The result of such methods is that the cheese lacks flavour and body. Hastening the process of cheese-making too rapidly is most undesirable; still, the manufacturer should see that he has a proper amount of acidity in the milk before adding the rennet. He may say that he would have too long to wait if he allowed the milk to get properly ripe. He should remember that waiting half-an-hour at this stage means the saving of an hour or more in the later stages of manufacture. The cheesemaker has no need to wait more than 45 minutes for milk ripening. He has means at his disposal whereby he can hasten the ripening process, bringing the milk to the exact degree of ripeness in a comparatively short time. This is by using a starter of some kind. We have various starters—sour whey, soured milk, or home-made starter and pure cultures. The first of these has been used by many makers for years. The risks run by this method are great, as one day's contaminated whey may taint the rest of the season's make of cheese. I have often had good results by the use of sour whey, and I must confess to bad-day makes. Whenever I had occasion to use whey, it was because I had no other means to produce acidity at my disposal. If I had tainted curd from the sour whey system, the next day I would allow the milk to ripen by heating it up to about 90 degrees F., until the required acidity developed, unless during the interval I had obtained a reliable starter. The temperature would then have fallen to about renneting point. When whey is good it can be safely used and good results will be obtained; but when tainted, what is supposed to act as a "starter," is a "finisher" as well. In these days of keen competition we want something that can be relied upon. For the attainment of this end, the home-made and the pure culture starter can be recommended, provided care is taken in the making of same.

Home-made Starter.

To prepare this the cheesemaker should obtain two buckets provided with covers (enamelled preferably). In the one he pours fresh milk (skimmed), and then sets it in a fairly warm place free from any objectionable smells, so that in twenty-four hours the milk will be both sour and thick. When this has occurred he skims off the surface, breaks up the centre of the mass and takes out half a pint. This he adds to skimmed milk which has previously been scalded to 170 degrees Fahr. for an hour, and subsequently cooled to about 70 degrees. On the following morning this should also be sour and thick. or the temperature of setting has been too low. Again the surface is skimmed, half a pint extracted as before, which in turn is added to a third quantity of scalded milk. The temperature at which the second, and all succeeding starters are made up, must be determined by each worker for himself. It will depend upon the temperature of the room in which the pail is kept during the night. On the third day the starter produced in this way, if of a creamy consistency, may be used for making the cheese, a portion, however, being retained to prepare a starter for the following day. This process may be repeated from day to day, and if performed in a careful and cleanly manner, good results can be obtained. It is always best to use separated milk; but it is sometimes impossible to obtain this, at a cheese dairy particularly. New milk can be used. Select a healthy cow, one that has been calved at least six weeks. The milk of strippers should never be used. The milk bucket should be thoroughly cleansed and scalded, the udder of the cow washed and dried, and the hands of the milker going through the same process. The first milk should be drawn on to the ground, as not only does it contain many injurious germs, but it is also of little commercial value, so that the thrifty man need not be alarmed at what may seem to him waste. This milk is treated in exactly the same way as the skimmed, and provided every care is taken, excellent results may be achieved.

Pure Culture Starters.

The use of these has already been explained in the *Journal*, but in an article such as this, devoted to starters and their uses, it may not be amiss to state the process of making same again. Take 10 lbs. of fresh milk (skimmed preferably); be sure that it is thoroughly clean; heat it up to 180 degrees Fahr., and keep it at that temperature for an hour or so; then cool down to 85 degrees, and add the pure culture, which can be obtained from the Department in liquid form, or in powder from various agents in Melbourne dealing in dairy requisites. The culture should be well stirred in the milk with a well scalded glass rod or stick made of some non-resinous wood; set in a pure atmosphere, retaining the heat as near as possible to 85 degrees. This is known as the "mother starter," and should be ready for use in from 18-24 hours, showing a smooth coagulation, and have a sharp, clean, acid taste. About 5 to 7 per cent. of this is taken from the centre and added to a fresh supply of pasteurized milk. This is kept at a lower temperature, and when thick and sour is ready. It is used subsequently in the same way as in the case of the home-made starter. This process is done daily, until the starter begins to go "off," or should the curd have a bad flavour the cheesemaker ought to at once obtain a fresh bottle of culture, and proceed as before. As in making home-made starter, new milk can be used by exercising the same care in the selection of the milk, and attention to cleanliness. A pure culture starter if kept under proper conditions ought to retain its good qualities for several weeks.

Experiments with Starters.

As to which is the best starter to use is a question that cannot be answered easily, as experiments conducted by Professor J. R. Campbell prove that good results can be obtained from either. Professor Campbell undertook the supervision of experiments to test the value of pure cultures of bacteria for cheddar cheesemaking for the Kirkcudbrightshire Dairy Association in 1897. The first experiments yielded results so favorable that a considerable number of the best cheesemakers were induced to test the cultures on a large scale. Over 100 tons of cheese were made from milk inoculated with the pure culture. Cheese made in this way was considered at the close of the season not only perfectly normal, but further, it was found that the use of the cultures was a safeguard against discoloration, soapiness, bad flavour, and want of uniformity. The general results of Professor Campbell's investigation showed that the organism used in the preparation of the pure cultures was one which is always plentifully found in good cheese, sour milk, and sour whey. Samples of milk were obtained from eight districts widely separated, both in England and Scotland, and each sample was found to contain large quantities of the bacterium which appeared to be the one necessary for the production of good cheese. It was concluded that this organism, and this one alone, was sufficient, from a bacteriological point of view, for the manufacture of first-class cheddar.

An experiment in connexion with one part of the investigation yielded results so important to the practical cheesemaker, that it was decided to follow it up with others of a similar nature during the succeeding season. A sample of sour milk was found to contain in considerable quantities at least three distinct organisms. One, which was present in largest numbers, was to all appearance identical with the organism found in good cheese, and identical also with the pure cultures distributed to cheesemakers. The other two organisms differed from this in one important respect, viz., they grew luxuriantly on gelatine, and on this account their colonies were very easily distinguished from the minute ones produced by the first organism, which, as already stated, closely resembled the pure culture bacterium.

A portion of this milk was used to inoculate a tube of sterilized milk, which on the following day was found to be quite thick. A portion of the contents of this tube was then transferred to a second tube of sterilized milk, the contents of which also soured and coagulated in less than a day. A portion of the contents of this second tube was transferred to a third tube of sterilized milk, which in turn was thick on the following morning. This process of inoculating a tube of sterilized milk from the freshly coagulated tube was repeated daily for some considerable time. The final product was then examined, and it was found that the useful and desirable organism in cheesemaking alone remained; the other two species, present in the original milk, had completely disappeared. The result itself is of great practical importance to the cheesemaker, because the system of inoculating a series of milk tubes, as already described, is imitated by the cheesemaker in his method of preparing a daily starter. Of course test tubes are not used by him, but ordinary dairy utensils. Enamelled pails are used for scalding the milk intended for a starter, and as the one milk tube was always inoculated from the preceding one, so the contents of one pail are always inoculated from the starter prepared on the previous day.

The chief points of difference in the two processes are these: (1) In the laboratory, tubes containing sterilized milk were employed; in the dairy, pails containing scalded milk were used. (2) In the laboratory special precautions were taken to prevent the entrance of foreign bacteria; in the dairy it is not possible to completely guard against the entrance of undesirable organisms; but it is proved by results obtained by the dairyman working with ordinary utensils that a product was obtained quite as free from foreign bacteria as if he had prepared his starter from a pure culture. The pure culture must be carried on from day to day under the same conditions as an ordinary starter, both being liable to slight contamination from exactly the same sources.

Professor Campbell conducted a large number of experiments to demonstrate the purifying effects produced by the method employed by the dairyman in preparing his daily starter. One experiment was done as follows: A bacterium which brings about the coagulation of milk by the production of lactic acid, was found in a sample of milk. This organism, like the bacterium used in pure cultures, grew rapidly, and in pairs in the form of a figure 8. In size, too, it resembled very much the bacterium of the pure cultures, but it differed from it in that it grew very luxuriantly on gelatine and agar. A pure culture of this organism was prepared in milk containing the organism used in the pure cultures. From this mixture a portion was taken to inoculate a tube of sterilized milk, which on the following day was found soured and thick. From this, one minute portion was transferred to a second milk-tube, and another equally small portion was taken, and from it gelatine plates were laid in order to determine in what proportion the two organisms were present. When the second tube had coagulated, two portions were taken therefrom, and used in a similar manner, one to show the relative numbers of the two bacteria, and the second to inoculate a third tube of milk. This process was repeated daily until eight tubes of milk had been inoculated, and a similar number of sets of gelatine plates prepared. When the colonies had developed sufficiently they were counted. The following are the results:—

Plates from tube No. 1 contained 5·5 of bacterium of pure culture to 1 of foreign organism.
Plates from tube No. 2 contained 32 of bacterium of pure culture to 1 of foreign organism.
Plates from tube No. 3 contained 38 of bacterium of pure culture to 1 of foreign organism.
Plates from tube No. 4 contained 732 of bacterium of pure culture to 1 of foreign organism.
Plates from tube No. 5 contained 1200 of bacterium of pure culture to 1 of foreign organism.
Plates from tube No. 6 contained the organism of pure culture only.
Plates from tube No. 7 contained the organism of pure culture only.
Plates from tube No. 8 contained the organism of pure culture only.

These results show that the system of preparing a home-made starter is quite practicable, and one which tends to the elimination of foreign and undesirable bacteria, and to the production of a starter containing the lactic organism only.

Experiment 2.—Another experiment was conducted in a similar manner, but in this case an organism which liquifies gelatine was placed in sterilized milk with the bacterium of the pure culture. The result was as follows:—

Plates from tube No. 1 contained 87 of bacterium of pure culture to 1 of liquefying organism.
Plates from tube No. 2 contained 510 of bacterium of pure culture to 1 of liquefying organism.
Plates from tube No. 3 contained the organism of pure culture only.

Other experiments such as those conducted by Professor Campbell prove that by starting with an ordinary sample of soured milk, even though it may contain undesirable bacteria, the operations entailed in preparing "a home made starter" will in a very few days produce a sample of sour milk containing what is for all practical purposes a pure culture of the bacterium required for the manufacture of good cheese. If the cheese-maker begins with a pure culture, in the course of a few days it will be no purer than a starter of the home made type. The aforementioned experiments also uphold the reasons that I have always given in advocating the use of a good starter, viz., that it aids in the overcoming of bad or undesirable ferments. The experiments also show that the cheesemaker will have more control over the manufacture and the production of cheese with proper flavour where starters are used judiciously. In order to confirm his belief in home made starters, and that the use of same is attended with practical advantages similar to those that may be obtained by the use of pure cultures, two sets of experiments were conducted, one early in July, and the other in August, at the dairies of the following gentlemen:—Messrs. James Robertson, Kirk, Devlin, Smith, McAdam, Kerr, and Connell. On Wednesday, the 29th June, the preparation of the home made starter was begun by these men, each working independently in his own dairy. The starters made on the first few days were discarded. On the 4th and 5th July they were used for making cheese. On the 6th and 7th each of them used a starter prepared from a pure culture. On the 8th and 9th the cheese was made from a pure culture grown in scalded whey instead of scalded milk. It was complained in previous experiments that the casein in the milk caused the cheese to be too firm, and that is why the experiments of the 8th and 9th July were conducted, to ascertain if such was the case.

The second experiments started on 1st August, and were conducted on exactly the same lines as the first set, by five of the aforesaid gentlemen, viz., Messrs. Robertson, Smith, McAdam, Kerr, and Connell. When the cheeses were made they were carefully marked, and placed in the curing room. Those of the first set were judged on 8th October, and the August-made on 29th October. Mr. J. Robertson, of Messrs. Clement and Sons, Glasgow, and Mr. Henry McFadzian, cheese instructor to the Wigtownshire Dairy Association, were appointed to judge the products. Great care was taken that no idea of the method of manufacture was conveyed to the judges. For this purpose the cheeses at each dairy were presented to them in an order different from that in which they were made, and at each dairy a separate order was adopted. On this account the results are of special value, and are the more reliable. The scale of points arranged was as follows:—Quality, 35; flavour, 30; texture, 15; colour, 15; appearance, 5—total, 100. The judges defined these properties of the cheese as follow:—

Quality.—Fatness combined with firmness of body as distinct from hardness and softness.

Flavour.—The properties that affect the sense of taste and smell.

Colour.—Uniformity of internal appearance—bright and clear as distinct from dull, cloudy, or mottled.

Texture.—The condition of the component parts as to solidity, as distinct from openness, and as to waxy smoothness of body as distinct from grainy roughness.

Appearance.—A thin intact skin as distinct from one that is thick and cracked.

The accompanying table gives the results. In studying the figures it will be well to compare the results of:—

(1) Home made starter with those of the pure culture starter.

(2) The pure culture starter in milk with the pure culture starter in whey.

(3) The pure culture cultivated in scalded whey.

It will be noticed that many of the cheeses obtained full marks, showing that the work was conducted most creditably by the cheesemaker.

TABLE I.—SHOWING COMPARATIVE EFFECTS IN CHEESE OF (1) HOME MADE STARTER; (2) PURE CULTURE STARTER IN MILK; AND (3) A PURE CULTURE STARTER IN WHEY.

—	Quality.						Flavour.						Texture.						Colour.						Appearance.					
Maximum marks ..	35.						30.						15.						15.						5.					
Starter used	Home made Starter.		Pure Culture in Milk.		Pure Culture in Whey.		Home made Starter.		Pure Culture in Milk.		Pure Culture in Whey.		Home made Starter.		Pure Culture in Milk.		Pure Culture in Whey.		Home made Starter.		Pure Culture in Milk.		Pure Culture in Whey.		Home made Starter.		Pure Culture in Milk.		Pure Culture in Whey	
Date ..	July.						July.						July.						July.						July.					
	4	5	6	7	8	0	4	5	6	7	8	9	4	5	6	7	8	9	4	5	6	7	8	9	4	5	6	7	8	9
DAIRY.																														
Robertson's ..	33	34	33	35	34	33	27	29	27	30	28	28	13	15	13	15	13	14	15	15	10	15	15	10	4	5	5	5	3	4
Kirk's	34	32	33	32	32	34	30	27	28	27	27	30	14	13	13	13	12	14	15	15	15	15	15	15	3	3	4	3	5	5
Devlin's	34	34	32	33	32	33	30	29	28	29	28	29	15	14	15	14	15	14	15	15	15	15	15	15	5	5	5	5	5	4
Smith's	34	35	33	34	35	35	26	28	29	20	30	18	13	14	14	13	15	13	15	15	15	15	15	15	4	4	5	5	5	4
McAdam's ..	32	32	35	33	35	35	27	30	30	29	30	27	13	12	15	12	15	12	15	15	15	15	15	15	5	5	5	5	5	5
Kerr's	31	35	34	34	33	34	28	29	30	30	29	29	12	15	15	14	14	15	15	15	15	15	15	15	4	5	5	5	5	5
Connell's ..	33	35	35	35	35	35	27	28	30	30	30	29	15	15	15	15	15	15	15	15	15	15	15	15	5	5	5	5	5	4
Daily Totals .	231	237	235	236	236	239	195	200	202	195	202	190	95	98	100	96	99	97	105	105	100	105	105	100	30	32	34	33	33	31
Total for each starter	468		471		475		395		397		392		193		196		196		210		205		205		62		67		64	

Second Set of Experiments.

Date ..	August.						August.						August.						August.						August.					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
DAIRY.																														
Robertson's ..	35	35	35	35	33	35	29	30	29	29	27	27	14	13	14	13	13	12	15	8	8	14	15	15	5	5	5	5	5	5
Smith's	35	35	35	34	35	35	30	30	30	28	29	26	13	15	15	13	15	15	15	15	15	15	15	15	5	5	5	5	5	5
McAdam's ..	35	35	33	32	33	32	30	28	30	27	30	27	15	15	14	12	15	11	15	15	15	15	15	15	5	5	5	5	5	5
Kerr's	34	35	33	35	35	33	29	30	28	30	30	28	14	15	14	15	15	14	12	15	15	15	15	14	5	5	5	5	5	5
Connell's ..	33	35	34	33	32	33	27	29	28	27	28	22	14	14	15	14	15	15	15	15	15	15	15	15	5	5	5	5	5	5
Daily Totals ..	172	175	170	169	168	168	145	147	145	141	144	130	70	72	72	67	73	67	72	68	68	74	75	74	25	25	25	25	25	25
Total for each starter	347		339		336		292		286		274		142		139		140		140		142		149		50		50		50	

Compared under each head the total marks obtained by the use of a home made starter, and those obtained by the use of a pure culture starter, the difference is very slight. It is hardly possible for even the best cheesemaker to produce exactly the same quality of cheese on consecutive days. We may therefore assume that the difference might be on either side, and that good results can be obtained by the home made starter. It is also evident that good starters can be obtained by adding cultures to scalded whey. There is one point in favour of a milk starter, and that is the cheesemaker is able to judge somewhat of the strength of the starter by the condition of the casein in it. Whey, on the other hand, has been deprived of its casein, and the cheesemaker has to judge of the strength of its acid by taste and smell only. One important point in using starter is to keep up its strength. It is probable that those who use the whey starter would fall into the mistake of allowing the starter to weaken more readily than he who employs a milk starter, and it is in this point that milk as a starter appears to possess a value over whey for the same purpose.

Practical Conclusions.

From a study of Professor Campbell's tables, the practical cheesemaker will be correct when he says that:—

(1) First class cheese can be made by using pure cultures of a lactic organism.

(2) This organism abounds in all samples of sour milk and sour whey.

(3) The system as before-mentioned in the preparation of a home made starter is one which exerts a purifying influence upon the bacterial contents of the starter, and results in the elimination of bacteria which are unnecessary and harmful to the production of a first class material.

(4) The use of a whey starter is attended with results equal in every way to those obtained from a milk starter, there only being the liability to dangers as aforementioned.

THE PRECAUTIONS IN THE PREPARATION AND USE OF STARTER.

In the preparation and use of starter some precautions are necessary.

(1) See that the cow (if new milk is used) is in the pink of health; that she has been a month or two in milk, but not stripping; that the udder is washed and dried; that the first few drops in the teats remaining from the previous milking are drawn on to the floor; that the buckets are washed and scalded; that the milker's hands are thoroughly clean.

(2) That the milk is strained and scalded as early as possible after milking; that the temperature is kept at about 175°-180° for about an hour; then aerated by pouring from one bucket into another, see that both buckets are scalded; that the cooling be done as quickly as possible to the desired temperature; and that the starter for inoculating be introduced when the proper temperature is reached. Do not stir the propagator into the milk with any old stick you can lay your hands on. Have a glass rod or an enamelled spoon for the purpose.

(3) Immediately after the propagator is stirred in, cover the bucket up, and set in a fairly warm place, but be sure that there are no obnoxious smells in the immediate vicinity.

(4) The starter must not be allowed to become weak. If it shows signs of doing so, use a larger quantity of the previous starter to inoculate

the one to be used on the following day, and see that it is placed where the temperature in the morning does not fall below 60° F.

(5) In adding starter to the milk, never add more than 34 per cent., dilute in fresh cold water, and strain into the vat. The habit of pouring the starter right in is dangerous, as the colouring will not take effect upon the lumps. Whereas, when strained, the curdy matter is retained in the strainer, and a danger that may cause discolouration is avoided.

(6) Always skim the surface off in the morning. The portion to inoculate for the following day's use should be taken from the centre, and kept in a covered vessel. Always add an amount of starter to scalded milk, so that you will have it of a pure velvety appearance the following morning, and free from whey on the top.

(7) When cheesemaking on alternate days, less starter must be added to the scalded milk. If in the opinion of the cheesemaker a few hours after inoculation it will be too far advanced before he requires it, he should set the bucket in cool water or a cooler room.

(8) Do not spare the cleaning and scalding of vessels used in this work. The greatest cleanliness must also be observed in the surroundings as well as utensils.

(9) If the starter begins to show signs of going "off," that is, having a bad flavour, the cheesemaker should immediately make a new one. A good starter is a splendid thing, but a bad one will cause what every cheesemaker should try to avoid, viz., bad flavours in the product. No matter how clean milking of cows is done, a bad starter will undo all the good that was previously done.

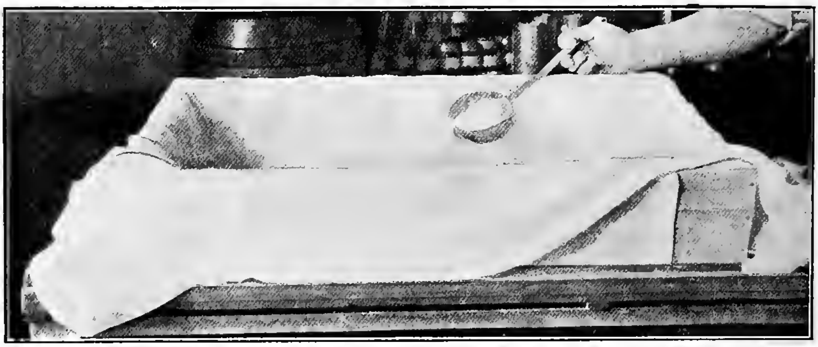
In summer it is not always necessary to use a starter. If the cheesemaker has means at his disposal whereby he can cool the milk to 60° 65°, in hot weather, he will benefit by the use of starter. No starter will ever be discovered, however, that will be capable of turning milk into good cheese without the exercise on the maker's part of cleanliness and intelligent observations. No amount of bacteria will compensate for a deficiency of that keenness of sense which is the result of long and patient training. Pluck is to be admired at most times. The pluck, however, of the man who rushes into cheesemaking without practical training for some considerable period, is not worthy of admiration. This kind of pluck not only makes the owner of the milk who employs such a cheesemaker suffer, but the industry generally is abused and brought into contempt.

THE MAKING OF FANCY CHEESE.

With the view of creating a demand for fancy cheese, I will give a description of a few of the simpler made kinds. The work of making soft cheeses is light, and suited admirably for women. The principal points to notice are: (1) Have the milk perfectly sweet at renneting, fresh from the cow preferably, and rennet added before losing the animal heat. (2) Attention at the different stages. (3) Cleanliness must be observed, particularly scalding water should be used freely on the utensils.

THE OUTFIT.

For any one going into soft cheesemaking it is desirable to have a building with three rooms: (1) making room, temperature about 60 to 65 deg.; (2) drying-room, about 58 deg. F.; (3) cellar that can be kept about 56 deg. F. The rooms should be built so that the temperature does not get too high or too low. If allowed to get too hot, the cheeses will be dry, and if too low, they do not drain properly, thus causing easy putrefaction and bad flavour. Though such rooms are desirable it does not follow that good cheese cannot be made in an ordinary cheesemaking dairy. It is only in case of any one going in for soft cheesemaking in a large way that I recommend such rooms. An ordinary cheesemaking and ripening room will do, as long as the temperatures can be kept about the points already mentioned.



LADLING OUT PONT L'EVEQUE CURD.

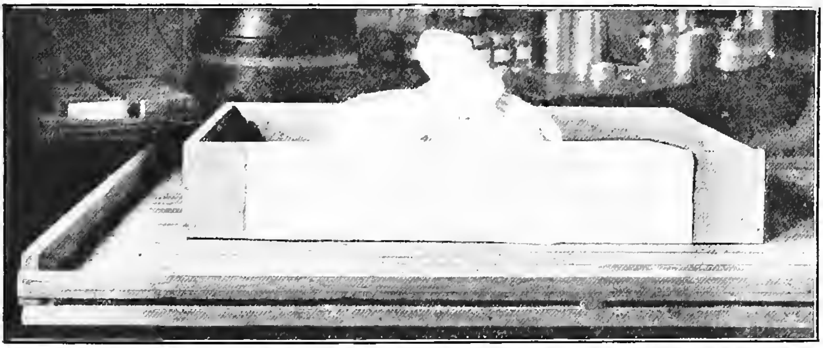
A table covered over with zinc and grooved at intervals so that the whey will all run to one corner is a good thing, as it prevents liability of bad adours arising from whey becoming decomposed on the floors. The vessels which are to contain the milk for renneting are best made of wood, as the temperatures are more easily maintained than by the use of tinware, though tin utensils can be used. Where wooden tubs are used they must be perfectly smooth inside, and well bound together with iron hoops. These tubs should be wider at the mouth than at the bottom, as the curd is not so liable to be broken in the ladling out. Never have them too big; tubs that will hold from 10 to 15 gallons are large enough. A ladle with sharp edges and a long handle is necessary; an ordinary soup ladle not enamelled will suit the purpose. Straw mats made by sewing rye straw together are also required. The straws should be of an even thickness. There are about 110 straws in a mat, which should be about 1 foot square. In France and other countries where soft cheeses are made, these mats can be purchased at a low figure. The making of mats is tedious work, so in place of the proper ones I have used uncoloured Japanese matting, which acts very well. This matting, when cut into proper sizes, must have the cross threads tied together to prevent fraying. Another necessity is boards, say, of kauri, 1 foot square, and about ¾ inch to 1 inch in thickness. Note that mats and boards must be thoroughly scalded before each time of using. The afore-mentioned articles are used in the making of almost all cheeses. The moulds that are used are of different shapes and make in each case, so will be mentioned under the heading of each variety.

PONT L'EVEQUE.

As this is probably the easiest made, and one of the finest flavoured, it is worthy of early mention. It is a variety with a great local reputation, and takes its name from a village in the north of France.

It is sold in large quantities in the fashionable watering places. The cheese is either square or oblong, and weighs about 10 ozs. Practically speaking, a gallon of milk will produce about two cheeses.

The details of manufacture are as follows:—Have the milk at a temperature of 88 deg. to 90 deg. F., and to every 10 lbs. of milk add about 2 to 2½ c.cs. of rennet, or enough to produce a firm coagulation in about half an hour. The rennet should be mixed with cold water, and stirred in for four or five minutes. This dilution of the rennet applies in all cases of cheese-making. When stirring is completed the tub is covered over with a wooden lid, or thick cloth. When the correct firmness of curd is acquired it is nearly as firm as for cheddar cheese, which is known when the curd makes a clean break over the finger, inserted under the surface. When this condition is obtained, the curd is cut with a long knife into widths of about 1½ inches, and then cut diagonally; by doing this the ladling-out process gives us cubes. Lay a rack with raised edges on the draining-table, and on this spread a piece of ordinary cheese cloth previously wrung out in scalding water. The curd is then ladled out, the ladle being passed through the curd sharply, so as not to break or bruise, and removed with equal gentleness into the rack already mentioned, where it immediately begins to part with its whey. As the whey runs off the curd toughens, the ends of the cloth are drawn together gently at first, gradually increasing the pressure at each consecutive tightening. This tightening goes on for three or four hours, until the curd can be handled, and placed in the metal moulds, which are made in accordance with the size the cheese is intended to be. The moulds used by the Department are 5 inches in length by 4 inches wide by 1½ inches deep, being simply a strip of tinned steel brought into desired shape, and soldered. There are neither bottoms or tops in this mould. Previous to filling the moulds are placed upon the mats laid on boards about six on each board. The curd should be filled in with a spoon or large spatula, and should be well pressed into the corners of the mould. The surface of the cheese should be as smooth as possible. Immediately on filling a tray of moulds a little salt should be sprinkled on the top side, about half a teaspoonful to each side. A clean mat is then placed over the moulds, then a board. Hold the top board firmly with the left hand, so as the moulds will not slip, then by holding the bottom board with the right hand the tray is turned over, and the first used mat and board lifted off, washed, scalded, and allowed to



PONT L'EVEQUE CURD TIGHTENED UP TO DRAIN.

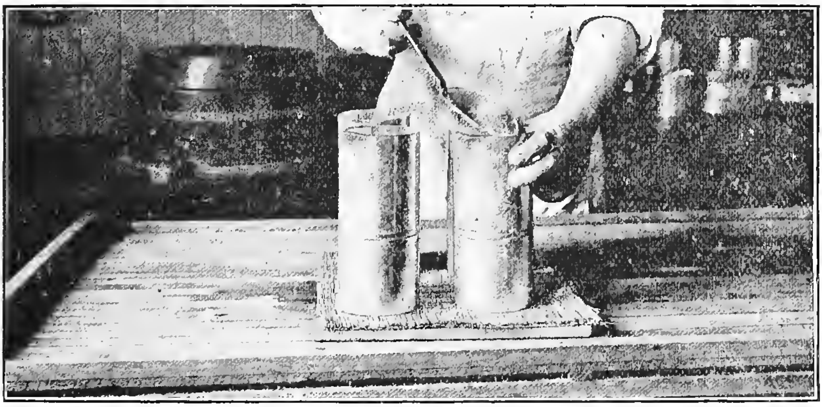
dry in the open air. Next morning the cheeses are salted on the side not previously done, and again turned over. If turning is done properly whilst in the moulds, both sides of the cheese will be free from fractures, and both have the marks of the mats upon them. Where a large quantity of cheeses is made, the mats and boards are numerous, and provision should be made for the moulds to stand side by side, in order that space may be economized. The cheeses will have shrunk enough in about two or three days to allow the moulds to be taken off. It will be noticed that when the moulds are removed that there are holes on the sides that were not in contact with the mats. These holes are filled up by scraping the sides with a table-knife previously dipped in scalding water, and wetted occasionally whilst scraping is continued. Scraping should be done from the ends inwards so as not to break the corners. The cheeses are then taken to the curing-room and placed on the shelves with mats spread on them. The mats can be long enough to cover one shelf. Whilst on the shelf the cheeses should be turned daily on to clean mats, for the first ten days at least. Fungi then gradually appear on the outside of the cheese until it is ultimately covered with blue. This growth depends upon the temperature adopted, and the humidity of the room. It is essential to maintain the moist character of the cheese, and to prevent the evaporation, which, if allowed to continue, would cause it to become dry and unpalatable. If cheeses happen to get dry, damp with whey, and place above each other. Pont l'Eveque cheeses are ripe in three to six weeks, but are good at the end of two or three months.

PONT L'EVEQUE MOULDS ON MATS AND BOARDS.

COULOMMIER.

This is a soft new milk cheese, made from whole milk only. Take, say, three gallons new milk at a temperature of 84 deg. to 86 deg. F., add five or six drops of rennet in water to each gallon of milk. Stir well in, and leave in covered vessel until sufficiently coagulated, which will take about six or eight hours. During the first two hours the milk should be carefully stirred from time to time, so as to keep down the fat. Care must be taken not to stir after coagulation, or result will be a broken curd. As soon as curd is a little softer than that for cheddar, it should be ladled out into the moulds placed on mats. These moulds are in two parts, the top part fitting easily into the bottom half. The diameter of this mould should be about 5 inches, the bottom half about 2½ inches high, and the top part 3¼ inches in height, making the total height of mould 5½ inches to

5¾ inches. The ladle is similar to that used in the manufacture of Pont l'Eveque. Ladling is done direct into the moulds in thin slices (it has not to be cut the same as in Pont l'Eveque), which must be laid down gently inside the mould. Breaking the curd up too much is liable to cause too rapid draining, therefore a dry cheese. When ladling out the mould should be held with one hand, so as to prevent it tumbling over. It is better only to ladle in a little curd up to the top of the bottom half, and allow to settle five or ten minutes before ladling in the whole amount, as this prevents loss by the top weight of curd squeezing it out at the bottom of the mould. When the moulds are filled up they are left to drain. As soon as curd has sunk to level of lower half of mould, remove the upper half, and turn the cheeses on to a clean straw mat and board. The cheese should be salted by sprinkling a little salt on top before turning. Turning should be done every six hours, until they begin to shrink from side of tin, when the moulds should be removed and the cheeses put in a cool place if required, or packed up in grease-proof paper, if for immediate sale.



FILLING CURD INTO COULOMMIER MOULDS.

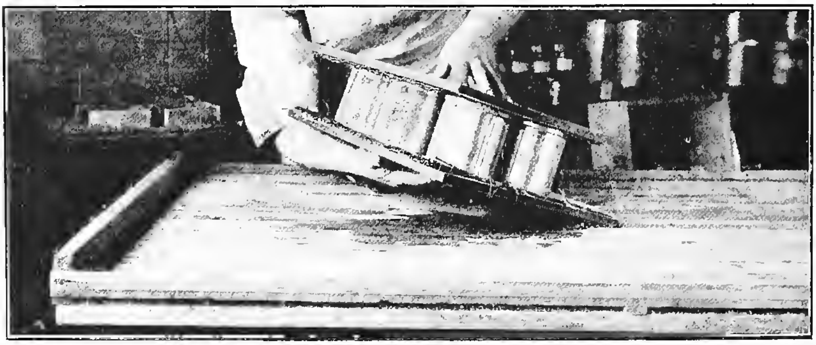
The Coulommier is made principally in the Brie district of France. It is one of the most delicious cheeses, resembling the Camembert in many ways. It can be sold at the end of a week with great advantage, but ripened and sold at the end of six or eight weeks it is infinitely more delicious.

GERVAIS.

This cheese is a delicate luxury, produced on a very large scale in some parts of France, whence very large quantities are shipped to London. Gervais is a mixture of cream and milk. Every maker has his own idea as to what proportions of each are necessary, but one-third cream and two-thirds of average milk will produce a most palatable cheese. Mix them thoroughly together, and set at 60 deg. to 65 deg. F. Add about two drops rennet for each quart of the mixture, and stir at intervals until it shows signs of coagulation. Coagulation is not complete for from 12 to 24 hours, some makers allow 36 hours, when the curd is ladled into a huckaback cloth, so as to extract the whey. The ends of the cloth are drawn together, and a string tied round. The bundle is then suspended until the curd is sufficiently firm to be removed to the Gervais press. The curd is then pressed between two boards, and a fairly heavy weight placed upon it. Examination takes place from time to time until the curd is perfect in texture. It should not be gritty, but smooth. If it should happen to be gritty it should be squeezed through a cheese-cloth. When properly firm a little salt can be added by mixing it with a spoon throughout the mass. The curd is then placed in little moulds 2¼ inches wide by 1¾ inches deep, which have been already lined with specially-made unglazed paper, in order to envelop each cheese. These cheeses are extremely profitable, and can be used at once. Three quarts will usually make about one dozen cheeses.

BONDON.

Bondon is another cheese native to France. It is produced entirely from milk. The process of making is as follows:—Take one gallon of new milk, add half-pint of buttermilk, set at 60 to 65 deg. F. Add two to four drops of rennet per quart of milk, and stir for a few minutes. In from 18 to 24 hours the curd should be fit for removal. It is ladled, when firm, to a strainer cloth, which has been stretched by the four corners over a vessel somewhat resembling an ordinary wash-tub. Here it gradually loses its whey, being occasionally and gently moved by scraping with a spoon, when the curd forms a coat which prevents the passage of the whey through the cloth. When sufficiently drained, it is removed into a clean cloth, and pressed between two boards, under a weight of about 14 lbs. The right consistence having been obtained, a little salt is added and mixed well in. If the curd be gritty, it should be treated the same as in the case of gritty Gervais. The curd is then placed in moulds 2¾ inches high and 1¾ inches diameter, previously lined with grease-proof paper. One gallon average milk will make six to eight cheeses.



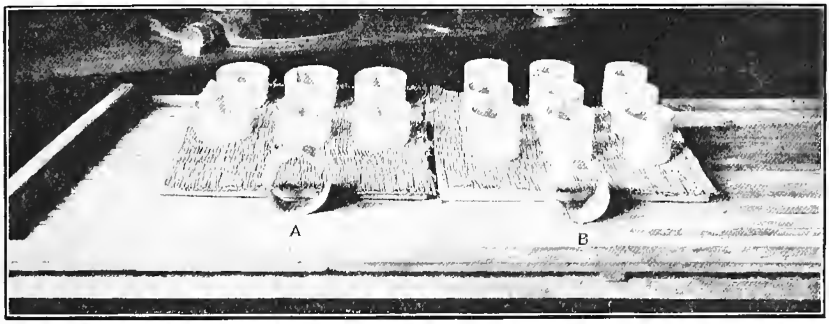
TURNING THE MOULDS ON TO FRESH MAT AND BOARD.

PHILADELPHIA OR SQUARE CREAM CHEESE.

This is a cheese, the manufacture of which is similar to that of the Bondon, but made of moderately-rich cream, three drops of rennet being used to each quart. It is moulded in flat, thin cakes, 3 inches by 4 inches, in a flat tin mould, and packed in parchment paper for almost immediate consumption.

SWISS CREAM CHEESE.

Take 1 gallon of fairly-thick sweet cream, at temperature of 60 deg. to 65 deg. F., and add to that five drops of rennet; stir this well in, and cover up and leave for about 12 to 24 hours. By this time, it should be like clotted cream. It is then emptied into a draining-cloth, huckaback towelling preferably. It is salted by sprinkling half the amount of salt on cloth before putting curd in, and the other half on the top of the curd when put in. Use about 2½ ozs. of salt to each gallon of cream. The reason for scattering salt on cloth is that it facilitates draining. Draining takes about twelve hours. The bundle should be taken down occasionally, and the curd scraped off cloth with a spoon to further assist the drainage. The curd should then be fairly dry, and should then be put between boards, with 8 to 10 lbs. weight upon it for every gallon of cream used. The lower board should be perforated. When firm, the curd is put in moulds lined with paper. The moulds can either be round or square, and made to hold about 3 to 4 ozs.



(A) GERVAIS MOULDS. (B) BONDON MOULDS.

DOUBLE CREAM CHEESE.

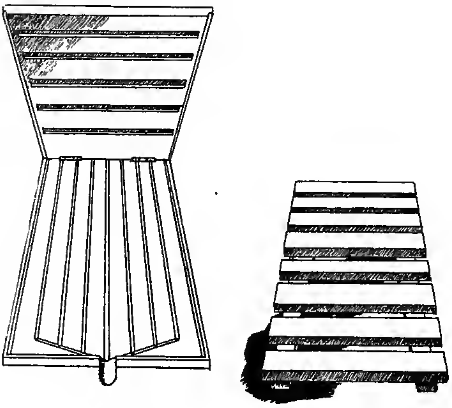
Thick sweet cream, without rennet, is used. Set at from 58 deg. to 60 deg. F. Hang up in a linen cloth, or place over a rack. Change the cloth occasionally, to assist drainage, until the cheese is firm enough to mould. Moulds are 2¾ inches by 1½ inches, and hold about ¼ lb. Line with grease-proof paper, or with muslin. Usually made without salt, but a little can be added if desired. One pint thick cream will make about three ¼-lb. cheeses.

CAMBRIDGE CREAM CHEESE.

To 16 lbs. of new milk, add 1 pint sweet cream; raise temperature to 86 deg. to 88 deg. F. add 1½ c.c. rennet. Stir well in, and then stir gently till coagulation begins; then cover up. When curd is firm, take thin slices of curd off top, and put on one side for a while. Scald moulds and mats, and place the latter inside lower frame of mould. These moulds are made of wood, are oblong, and are in two pieces, similar to the Coulommier mould, and should be large enough to hold about ¾ gallon of curd. The curd is ladled into the mould, and, when half full, that which was taken off the top is put in. When full, cover top with grease-proof paper, and allow to settle without turning. When dry enough, take away mould, hold cheese under a water-tap for a minute or two. Rub a very little salt all over. Place in ripening-room about 60 deg. F.

ST. IBEL.

Take a quantity of milk, and add a quarter its bulk of cream. Raise the temperature to 82 deg. F., and add a drachm of rennet to every 2 gallons. The draining is conducted in much the same manner as in the Pont l'Eveque, but is allowed to become firmer. When dry enough, the mass is tipped out on to a board, and kneaded with a rolling-pin to break up the lumps. When sufficiently free from grit, add a little thick cream, in which has been steeped for at least 24 hours mashed-up pieces of prime Cheddar. This cream is thoroughly mixed through the mass, and



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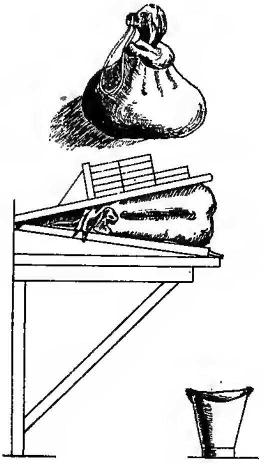

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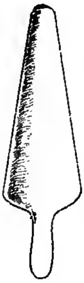

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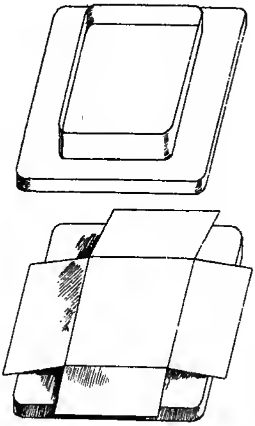

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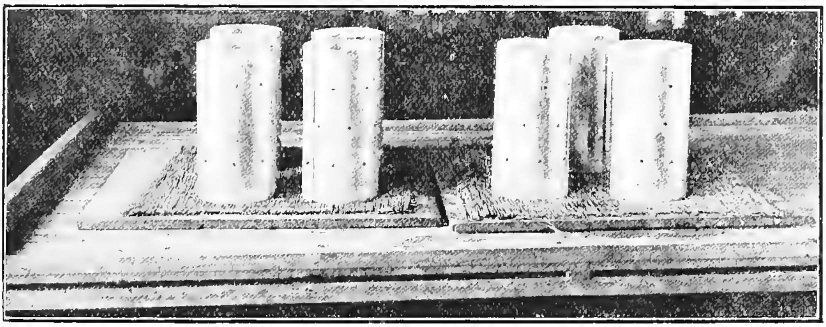
1. Cream Cheese Press and Rack.
3. Kneading knife.
2. Cream Cheese in cloth and in Press.
4. Cream Cheese mould.

then salt added, about 1 oz. to every 4 lbs. of curd. When the salt is sufficiently incorporated, the curd is placed in moulds, lined with muslin. This is a most delicious cheese, having the flavour of Cheddar, and the richness of cream cheese. A little colouring matter can be added to the milk if desired; 1 drachm to every 10 gallons will be sufficient. This cheese can be consumed almost immediately, or it can be kept for two to three months.

CAMEMBERT.

An article on soft-cheesemaking would hardly be complete unless mention was given to this brand. The moulds are all in one piece, but with perforations at intervals on the sides, and are about 5 inches in diameter, and 5½ inches in height, with open ends. The process of manufacture is as follows:—Take, say, 25 lbs. of morning milk, and a similar quantity in the evening, at a temperature of 80 deg. F. Add about 1 c.c. to 1½ c.c. of rennet, or enough to make the curd firm enough in four to five hours. The moulds are placed close together on mats, and they are half-filled with the morning's curd, and then filled to the brim with the evening's curd. Before adding the latter, the surface of the morning's curd must be broken, otherwise the cheese will not join together properly. On the following day, the curd having become partially firm by drainage, each mould is inverted on to fresh mats. This is a somewhat delicate operation, and skill is only acquired by practice. Turning continues about twice a day, until the cheeses are firm enough for the moulds to be removed. They are then salted alternately on each side, a little salt being rubbed in. They are then placed on mats on small boards placed on shelves in the making-room. Here they are turned regularly, until the white mould commences to grow, when they should be taken to the drying-room. In this apartment they remain until the blue mould commences to grow, when they should be removed to a cellar. There should be good ventilation and a slightly humid atmosphere in this apartment, otherwise the cheeses may be spoiled. With the continual growth of mould, ripening is pursued; insoluble curd becomes soluble, the flavour is acquired, and the cheese becomes fit for market.



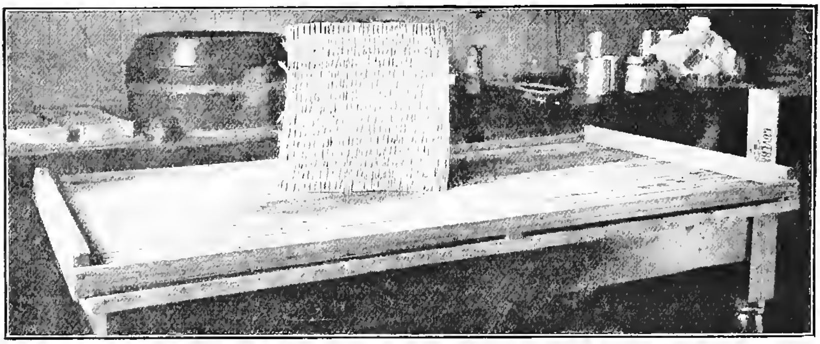
CAMEMBERT MOULDS.

During fine weather both rooms should be well ventilated, cross-draughts being arranged in the drying-room; but during wet weather draughts are excluded, and the room kept as dry as possible. A very damp atmosphere is injurious, as with excessive humidity the white mould changes to black, the latter being liable to produce bad flavours. Although

Camembert is not so simply made as some varieties, I have found it desirable to mention it, as it is such a profitable article, and one of the most favoured kinds, but it is one that requires a good deal of experience to make.

DUTCH OR COTTAGE CHEESE.

A toothsome and nutritious article of food is made from sour skimmed-milk, or buttermilk, by allowing the casein to coagulate by the action of lactic acid already formed, and then expelling the water by the aid of heat. The sour milk is heated to a temperature of 130 degs. to 135 degs. The whey is drained off the curd through a straining-cloth, and the curd is then kneaded by the hand; salt is added, and the product is improved by the addition of a small amount of cream or butter, and a little nutmeg or caraway. It is usually sold and eaten in a fresh state, but it may be subjected to certain curing processes, which materially changes its character.



DRAINING RACK AND STRAW MAT.

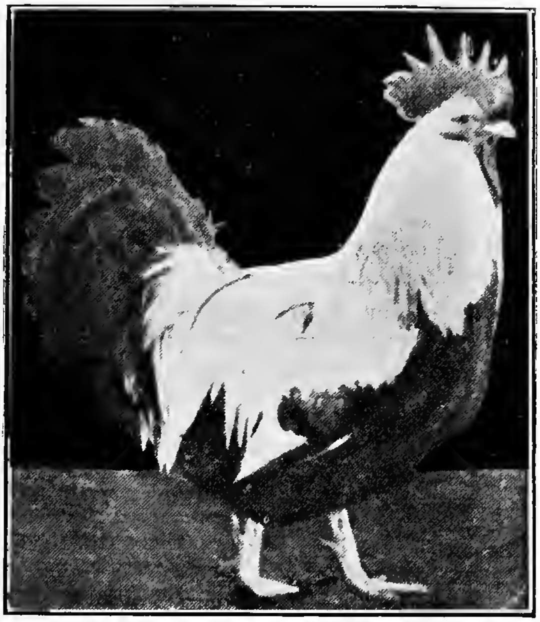
There are many other kinds of fancy cheeses, but as I have not had practical experience of the making, I cannot give instructions. Some people may say that I have not mentioned Stilton, this, however, is not termed a soft cheese, and as time will not permit me to give a full description of this fine cheese, I will deal with it at some future date. Besides this, there are many kinds of hard-pressed cheeses, other than Cheddar, worthy of public notice.

Before concluding, let me again impress upon intending soft-cheese-makers the following:—

(1) Be cleanly, using boiling water freely.
(2) Use only pure sweet milk, free from taints.
(3) Do not set at too high temperatures, as such are liable to cause dry cheeses, as also does excess of rennet.
(4) Do not treat curd roughly.
(5) Do not allow making-room to become too low or too high in temperature.
(6) Do not allow the cheeses, whilst draining in the moulds, to stand in a draught, otherwise drainage may be checked, causing fermentation.
(7) Always attend to the curd when ready for moulding.
(8) Keep curing-rooms at a proper temperature and suitable degree of humidity.

CHAPTER XVI.

POULTRY.



PURE SILVER DORKING.

As far as Victoria is concerned, the great importance of the poultry industry has, unfortunately, been overlooked in the past. There are, however, indications that apathy in this particular branch of rural pursuits will soon disappear. With the view to stimulating action by disseminating information on the subject, the following articles have been written by the poultry experts of the Department. It is believed that they will be exceedingly helpful to the beginner, and also of practical value to the farmer.

Apart from the poultry and eggs consumed by the farmer's household, the revenue resulting from the sale of similar produce is often considerable, and, consequently, the industry is an important factor in the success of every well managed farm. As in other departments of farm work, intelligence and constant care are necessary if success is to be attained.

The past year has been a very prosperous one for the industry in Great Britain, upwards of £10,000,000 worth of poultry and eggs having been produced. Notwithstanding this enormous production, it has been found necessary to import largely. There has been an improved demand, and prices have been more than maintained. Consumption of this particular class of food is growing, so there seems to be little fear of over production provided that poultry raising is conducted on right lines. In order to show the great possibilities of the industry, a perusal of the following figures relating to Great Britain is recommended.

IMPORTS OF GREAT BRITAIN.

EGGS (1904).			POULTRY (1903).	
From.	Quantities.	Value.	From.	Value.
	Dozen.	£		£
Russia	70,329,060	2,042,520	Russia	343,761
Denmark	36,023,260	1,461,459	Belgium	248,552
Germany	35,542,320	1,191,161	France	235,700
Belgium	25,170,730	837,120	United States ...	219,787
France	16,986,140	710,057	Other Countries ...	41,244
Canada	3,177,220	129,631		
Other Countries ...	12,197,210	358,626		
	199,425,940	6,730,574		1,089,044

ANNUAL CONSUMPTION OF EGGS AND POULTRY IN GREAT BRITAIN.

—	Eggs.	Poultry.	Total.
	£	£	£
Foreign Produce	6,730,574	1,089,044	7,819,618
Irish ,, ...	1,950,000	450,000	2,400,000
British ,, ...	4,700,000	2,750,000	7,450,000
	13,380,574	4,289,044	17,669,618

The latest returns show that the value of the production of poultry and eggs in Australasia during 1903 was as follows:—

New South Wales	£820,700
Victoria	719,900
Queensland	316,800
South Australia	319,800
Western Australia	199,800
Tasmania	108,900
New Zealand	500,200
	£2,986,100

The most remarkable feature is the trade in eggs between South Australia as supplier and the other States as buyers. The returns for 1903 show that during that year South Australia exported eggs to the value of £116,182 to the other States.—(*Coghlan*).

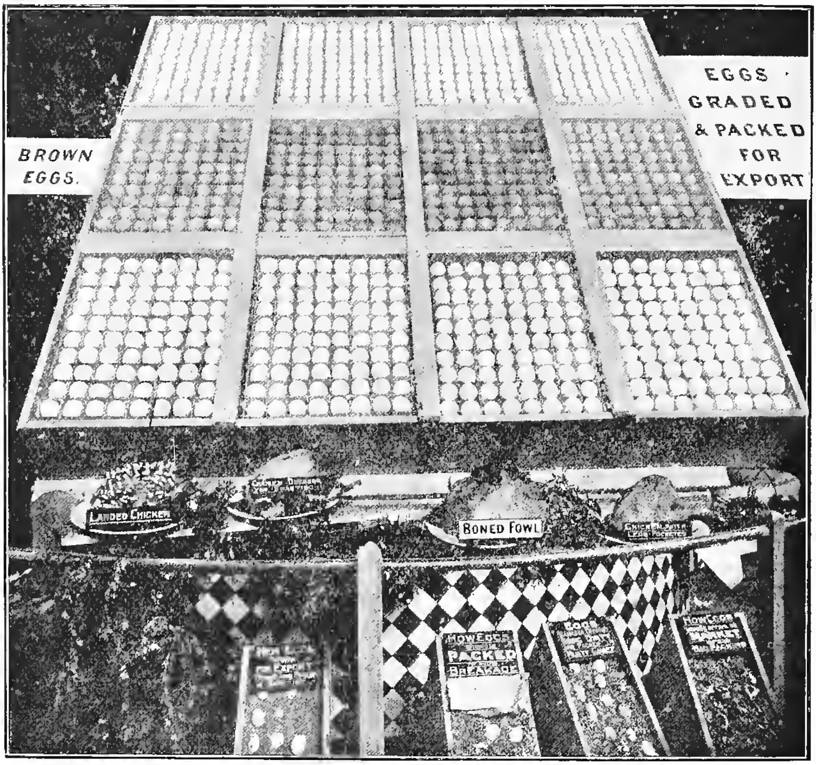
In order that the Victorian figures may be considerably increased, it is absolutely necessary that poultry keepers should aim at producing the finest quality of eggs and poultry. With this standard in view, and by grading the produce before marketing, satisfactory results will be attained. The various egg-laying competitions in the different States have been highly educational in this respect, and have done much to practically demonstrate that poultry raising can be made a paying adjunct to the farm. The twelve months' test at the Dookie Agricultural College, which terminated at the end of April last, has successfully proved the utility of the hen from a commercial aspect. The following figures relating to the leading pens (six birds each) show that there is profit in the poultry business if undertaken seriously. Of the 37 competing pens, in no less than 23 cases the total number of eggs per pen exceeded 1,000.

EGG-LAYING COMPETITION, DOOKIE AGRICULTURAL COLLEGE.

Breed.	Totals.	Total Weight of Eggs Laid.	Average Number of Eggs laid per Bird.	Market Value of Eggs.
White Leghorns	1,313	2660·5	218·8	99/11½
Minorcas	1,254	2749	209	85/8¾
Black Orpingtons	1,228	2566	206·6	90/10¾
Minorcas	1,218	2613·5	203	83/4
Pile Leghorns	1,212	2467	202	90/-
White Leghorns	1,210	2780·5	201·8	84/2½
Langshans	1,203	2513·5	200·5	80/11¼
Golden Wyandottes	1,198	2421·5	199·6	91/5¾
Andalusians	1,159	2495	193·2	81/2¾
Brown Leghorns	1,149	2413·5	191·5	80/10½
Silver Wyandottes	1,140	2468	190	82/2
Black Orpingtons	1,125	2425	185·8	77/5½
,, ,,	1,107	2360·5	184·5	73/11
Black Hamburgs	1,102	2168·5	183·6	74/6¼
Black Orpingtons	1,085	2390·5	180·8	77/2
Golden Wyandottes	1,053	2181·5	175·5	75/2¼
White Wyandottes	1,048	2171	174·6	79/8½
Black Orpingtons	1,047	2279	173·5	71/10½
Brown Leghorns	1,037	2137·5	172·8	69/5½
Black Orpingtons	1,037	2248·5	172·8	68/9½
Buff Orpingtons	1,036	2083	172·6	72/10¾
Silver Wyandottes	1,029	2075	171·5	72/6
Buff Wyandottes	1,011	2213	168·5	68/9½

BREEDING AND MANAGEMENT.

An industry of such importance as the poultry industry should be a matter of greater concern to the farmers of this State. For years past it has been held up to ridicule, even contempt; but, to-day we see a change, farmers are inquiring after knowledge, and are waking up to the importance of this industry, and recognising that with better stock, and greater care and attention, poultry can be made a very profitable part of the farm stock. This is shown by the large number of letters received weekly by the Department of Agriculture. Many of these inquiries call for replies, which would occupy much time, hence this article, which we trust will assist the farmer, and be a text-book for reference in most matters connected with poultry culture.



EGGS GRADED AND PACKED.

Importance of Locality.

Locality plays a most important part in the success or otherwise of poultry breeding. Badly drained, sour, or very stony land should be avoided, rather select a site having an easterly aspect, sloping so that early morning sun may sweeten the ground, which is a great factor in warding off disease. We cannot all secure sandy soil, but look for the loose soil, and wherever possible secure the sandy spot. It dries out quicker, and is much easier to keep clean.

The Breeding Pen.

Farmers know little or nothing about the breeding pen, but to my mind this is the key to success. The old idea of keeping a few fowls round the homestead is passing. The farmer should know something about the fowls he has. Before he thinks of incubating he should be careful to watch for the layer of 150 to 200 eggs, hence the necessity of a breeding pen. A fair sized pen, say, 100 by 25 feet, should be set apart for this purpose. First of all, run the plough round, making a trench of, say, 10 to 12 inches, place your posts (8 feet lengths) about 2 feet in the ground, 12 feet apart (good saplings barked will do), and before filling up the trench, run two rows of barbed wire all round. This will be a safe investment, and will effectively keep out foxes or wild dogs.

BREAK WIND.

After this, run a batten round, 3 feet from the ground, to keep posts straight, but on no account have any top rail, it only encourages the birds to fly over, and is also a source of danger where foxes are troublesome. They will never attempt to jump on wire mesh, but if you give them a foothold, trouble will begin. Use either 6 feet palings cut in half, or purchase sufficient malthoid or ruberoid, or, if funds permit, make a good job of it, and buy plain sheet iron. This should be nailed on to middle batten all round the pen, and will provide a splendid breakwind for the stud birds.

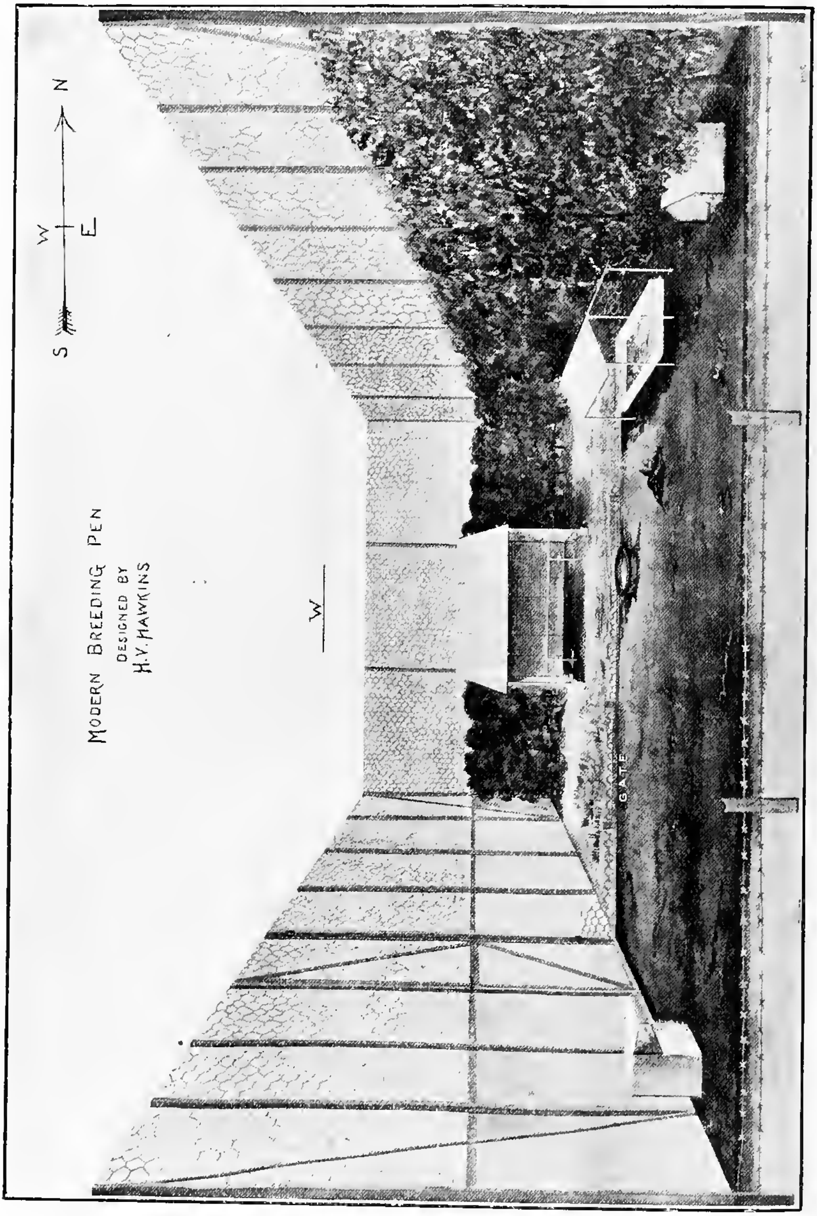
AN IDEAL SHELTERED FOWL RUN, SHOWING GROUP OF SILVER WYANDOTTE COCKERELS.

SHADE AND SHELTER.

It must not be forgotten that shelter is absolutely necessary in a breeding pen. The temperature of a fowl's body being greater than our own, it stands to reason that shade from the sun's rays must be provided. The best and most quickly grown shelter hedge is the tree lucerne (*Tagasaste*). It will grow in almost any part of Victoria, and will stand drought well. The tops should be cut every month, and utilized in the morning meal. Then it thickens and shoots out at the lowest part of the stem, throwing shade along the ground, where the birds can rest comfortably from sun and wind.

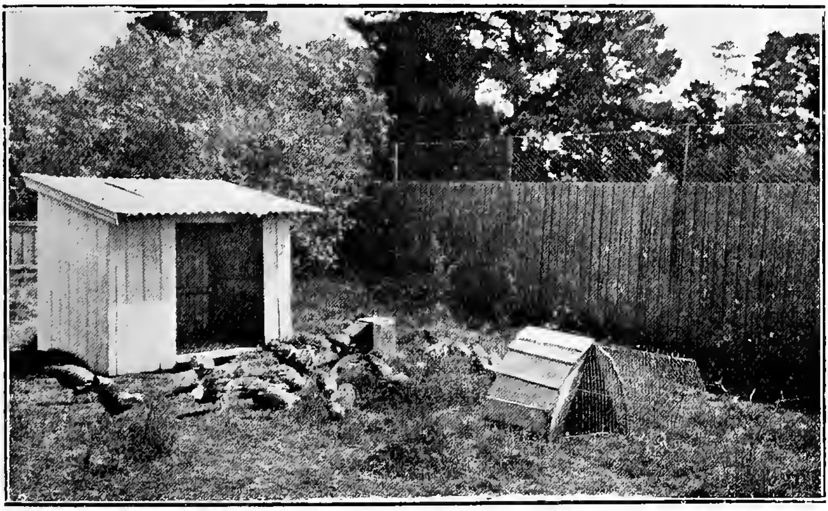
CONSTRUCTION OF HOUSES.

The next consideration should be housing in the breeding pen. A small portable house is all that is required to hold only such birds as are selected typical layers. Or you may wish to cater for the export trade. In any case seven to twelve birds will be sufficient in one pen, no matter what breed you intend keeping. The house should in all cases face the east, so as to get as much sunshine as possible. It is not necessary in this climate to build expensive or warm houses. The north, south, and west sides should be closed in, and should be quite free from cracks and draughts, the east side alone being entirely open. The roof should slope eastward, and project 2 feet over frontal uprights; this will effectively prevent an easterly rain



MODERN BREEDING PEN, 100 X 25 FEET.

(a rare thing) from driving in on the birds at night-time, and will allow rain to drop clear of the base of house. A good plan to safeguard the floor is to run a small piece of spouting round the house, and have the downpipe placed in position to carry the water clear of the pen. For example, a house 6 feet long by 4 feet wide, the back 5 feet, and the front 4 feet high, having a framework of light material, and wired over, west, south, and north sides, and fixed over the wire, "malthoid" or "ruberoid," will cost not more than 30s. Still better for the northern areas is "Uralite," a non-conductor of heat, but it is more expensive (fuller particulars of this are given in the *Journal* for May, 1904). Many make the serious mistake of coddling their fowls. Coming off the perch of a warm house at dawn in June, for example, the birds receive a severe shock, and very often take cold, which may lead to roup, the fowl's worst enemy. An even temperature, the house free from draughts, a dry floor, and ample ventilation, are all they require.



CHICKEN RUN, HOUSE, AND COOP, SHOWING SILVER DORKING CHICKS. SIZE 50 X 20 FEET.

PERCHES.

These should always be low. Eighteen inches from the ground is ample, and the perches should not be nailed. When nailed you have always to contend against the vermin trouble, which is one of the worst. The red blood-sucker, called Sarcoptes, if allowed sufficient latitude, will drain the system of any fowl, and the very essence of egg-production is drawn from the body of a hen in an infested house. It will pay better to secure insect-proof perches, which may be constructed as follows:—Have a piece of iron tubing 24 inches long, take an ordinary jam tin, cut a hole in bottom of tin sufficient to allow the tubing to pass up through the tin within 6 inches of the top, then solder the tin to the iron. The perch should be about 12 inches shorter than the length of the house. Bore a hole in both ends of perch the size of tubing, and when the tubing is fixed on to a heavy stand or driven into the floor, place the perch, which should be 3 in. x 2 in. hardwood, on top. Perches require to be about 3 inches wide to prevent crooked breasts. These are often caused through the birds roosting on narrow perches. When the perch is in position, pour a little kerosene into the tins at each end, and you will have insect-proof perches.

FLOOR CATCHMENT.

The continual cleaning of the floor is usually followed by the ground becoming basin-shaped, and the result is a damp floor in winter-time. A cheap and effective plan to prevent this is, to purchase a piece of black tarpaulin, about the size of the floor, nail this on to two pieces of wood, one at each end, and place on floor of house. Every morning roll this up and empty the droppings into a wheelbarrow. If the birds have been scouring, through eating too much wet grass, and the carpet of tarpaulin has become very dirty, remove it to a tap, and put the hose on. Then hang over a fence to dry. It is advisable to throw a little sand on to prevent the droppings adhering to the tarpaulin. This system works well, and saves a great deal of time, and prevents the spread of vermin.

TRAP NESTS.

Trap nests will assist the farmer to discover the good layers, and will enable him also to pick out the unprofitable birds, which latter are too often bred from unknowingly. These should be used for table purposes, and on no account waste food in keeping bad layers. Nests should never be made inside the fowl-houses, nor yet adjoining. The better plan is to have them in a shady, darkened spot, away from the house. If you allow the hens to make nests in the houses you encourage vermin.

DUST BATH.

A dust bath should be provided in every breeding pen, and should consist of a shallow box 5 by 4 feet, in which you place sand, ashes, and some sulphur, and a little insectibane. This should be shaded, and kept moist in summer time. Keep dry, and have a cover to take on and off in the winter months. Neglect of the bath means an increase of the fowl fleas, which, unlike the blood mites, which are only found out at night, and hide away during the day, live on the body of the hen, and drain it of much of the egg-forming elements. These parasites lay countless small white eggs, almost the size of silk-worm eggs, on the downy part of the feathers, especially under the wings and near the vent. In the early autumn, when the birds usually lose their old feathers, these eggs are carried all about the farm, are duly hatched, and return to the newly feathered flock, therefore the necessity of a dust bath is great, if we expect our birds to do anything above the old-time farmyard fowl. We live in the days of improved methods, and the more we attend to the little details, the better results accrue.

GRIT BOX.

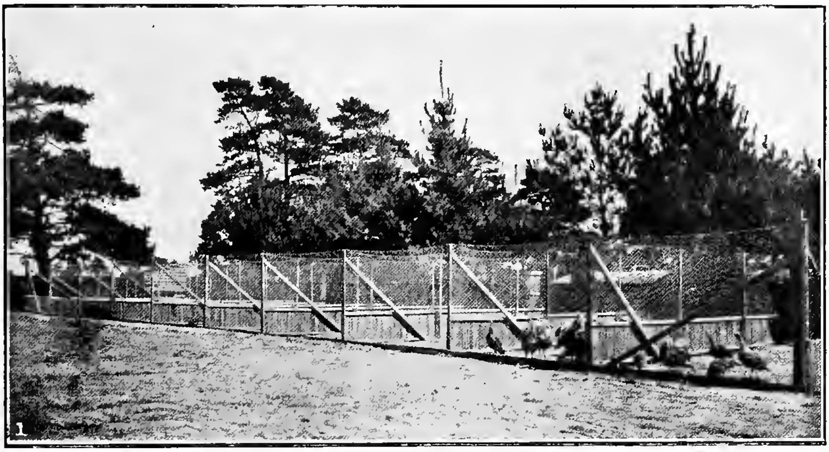
Every fowl requires some form of grit for the gizzard's proper work. Fowls have no teeth, and their only means of grinding is done in the gizzard by means of grit, say, sharp pieces of broken earthenware, smashed to the size of a pea, or half the size of a grain of maize. This form of grit is that most relished, and I have known birds to leave quartz until they have exhausted all the earthenware. Oyster shell broken into small pieces may also be given to assist shell making, but it is not hard enough to serve the double purpose.

DRINKING VESSEL.

Many poultry-keepers make the mistake of using open receptacles, such as an old saucepan or cracked dish, filling it up once a week, and allowing it to be exposed to the sun's rays. This is a serious error. Should a touch of disease appear on the farm, the bird affected naturally drinks a lot, and in so doing leaves the germs of disease behind for the others which follow, and so disease is spread broadcast. I maintain that the scalding of the tins is very essential. No disease spreads so rapidly as by means of infected drinking water. Keep the water cool and absolutely pure.

CHEAP WATER TIN.

This can be made out of a kerosene tin, cut from the front, half way down on both sides, and also again cutting it across the centre of tin. Raise the piece of tin slightly. It will not only form a shade to the water, but also more important still, it prevents the fowls' feet from getting into the water, and thereby forms another safeguard against disease germs. See modern breeding pen.



WINTER PENS FOR INTENSE EGG CULTURE. SIZE 36 X 10 FEET EACH.

A GOOD TONIC.

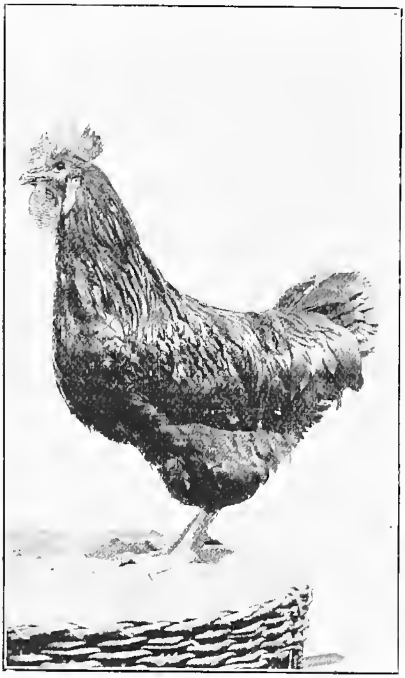
Keep an old rusty horseshoe in the drinking water, adding 80 drops sulphuric acid to each gallon. Once a month put a packet of Epsom salts to about half gallon. The colour of the comb should be observed, the whitish red, the blackish purple, or the very pale comb denotes something radically wrong. A bright, healthy, appearance is desired.

SELECTING THE STUD BIRDS.

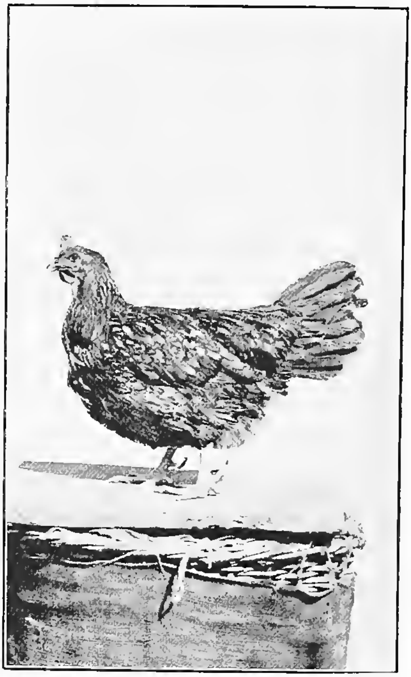
This is an important part, and great care should be exercised in selecting birds for the breeding pen. Too often farmers complain of bad treatment by the fancier. It is advisable to consult a specialist breeder who you know has a reputation to lose. He is an authority on most breeds, and is better able to choose your stock, and usually knows where to purchase sound, healthy birds, free from disease. Many make the mistake of buying at auction. The auctioneer does his utmost for his client, and often birds are sold as being pure bred, and in many cases which have come under my observation, half the birds offered have been cross breeds, and wasters at that. I wish to emphasize this, as many buyers have been so disgusted, and often a promising poultry farmer throws up the business, and the State becomes the loser.

COST OF STUD BIRDS.

Should you require birds for exhibition purposes, you must expect to pay high prices, but the Department does not encourage the farmer to go in for this class. What you want is either flesh or eggs, and it is generally conceded that pure bred poultry are far more profitable to the farmer than the old time "barn-door." Believing such to be the case, you need have no regard for feather points. Healthy culls, mismarked, are often better from the egg point of view than is the show specimen. By May of each year, the specialist breeder has already commenced to cull out, and you can always secure these at fair prices. In writing to the breeder, lay stress on these points: Is the strain noted for egg producing? Whose strain is it? Have the birds been inbred? What time were they hatched? If late hatched, avoid them. I must here give a hint regarding the above. In buying say ten Leghorns for the breeding pen, second season hens are best to produce strong chicks, mated with a young nine to ten months' old unrelated cockerel. Purchase the hens from one breeder, and the cockerel from another. The cost of Leghorns for utility purposes varies somewhat, but 10s. a head is not too much to pay for this breed, or for any of the other Mediterranean breeds, which include Minorcas, Leghorns, brown, buff, and pile, Anconas, Andalusians, &c. These are non-sitters, but are prolific layers if properly managed. When asked to name the best breed, it has always been my custom to inform inquirers that there is no best breed.



BLACK ORPINGTON COCK.
Weight, 9 lbs.



DARK DORKING HEN.
Weight, 9½ lbs.

A breed is what you and I make it. Constant culling out the unprofitable birds, and then breeding only from those hens that we know have laid 150 to 200 eggs yearly. By this means many breeds can be built up. I have never known a bad laying hen to produce an excellent laying pullet. Like produces like, especially in regard to poultry. But should you ask me what breed will suit the northern areas of Victoria for eggs, I should say White Leghorns. They stand the heat well, and are not so inbred as are many of the laced breeds. On the other hand, take the colder parts of Gippsland and the western districts, the Black Orpington, single or rose comb, will do remarkably well, and will bring good profits. One thing is necessary. They should be hatched earlier than the Leghorns, say August and September for preference. Leghorns should be hatched in September and October, and in cold districts a little later.

FIRST CROSS, SILVER WYANDOTTE AND SILVER DORKING.

THE ALL-ROUND FOWL.

I have already referred to two grand breeds suitable for the Victorian farmer as egg-producers, viz., White Leghorns for hot districts, and Black Orpingtons for the colder climate of Gippsland. Now a word or two for the first cross of two pure breeds. After making many experiments with many breeds during the last four years, to try to solve by actual test which two breeds when crossed would produce eggs and flesh, I unhesitatingly say that the cross of the *Silver Dorking* and *Silver Wyandotte* has the strongest claim. Briefly put, the last test I made was between five breeds, viz.—Dark Dorking with Plymouth Rock, Dark Dorking with White Wyandotte, and Silver Dorking with Silver Wyandotte. All were hatched the same week, and fed on the same ration. The result of test was in favour of the Silver Dorking and Silver Wyandotte, which produced in a twelve month's test, 219 eggs. The second place was filled by the Dark Dorking and White Wyandotte, which laid 189 eggs. The third being the Silver Dorking and Plymouth Rock, 178 eggs. This in itself is a splendid record in eggs alone. I may mention here that the cockerels of the Silver Dorking and Silver Wyandotte cross at 5½ months old averaged 7 lb. in weight. They were kept in separate yards, and it is questionable whether any of the non-sitting breeds, bred pure, can show better results. Of one thing I am confident, few birds equal to this cross for the table can be found. The cockerels and pullets make splendid plump, low-set birds, with long keel, and with beautiful white succulent flesh. At 5½ months they weighed 7 lb., and were very easily reared. I would strongly recommend this first cross to the farmers of Victoria.

It may interest my readers to know how to mate these two breeds. Select carefully six second season Silver Wyandotte hens from a good laying strain, and a Silver Dorking cockerel, under twelve months old, also from a good laying strain. Place them in a breeding pen about the first week in June, and feed, as I shall direct later on, on a strong nitrogenous ration. When they start to lay, put aside the first three eggs from each hen for eating purposes. After they have been mated up fourteen days, gather the eggs carefully, and place them in a cool room on their sides, turning slightly twice weekly. When you have a setting of twelve and a broody hen ready, set them, and probably by the 21st of July you will have a batch of chicks. You have then what are correctly called early chicks. These early birds will produce large quantities of eggs when prices are high. Fifty early chicks are worth 150 late hatched ones. My experience has proved this over and over again.

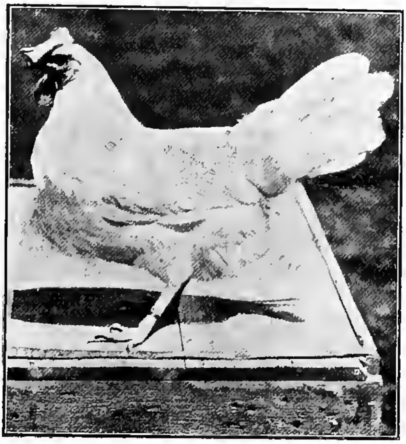
THE IDEAL FOWL FOR THE LONDON MARKET.

The best bird for export is the Indian Game and Dorking cross. The flesh is beautifully white, very tasty, and there is plenty of it. While many of the leggy breeds are making bone and feather, birds of this cross are putting on breast flesh, and but little feather. The more comb and feathers a bird has, the more nourishment is required to keep up that comb and the feathers. The less feathers and comb to feed, the more flesh or eggs will be produced. The less feather a bird has the better, for it is easier plucked, and there is less vermin to cope with. This in itself is a strong argument in favour of this cross. I am instructed to deal with only the best breeds. But it is very desirable, where there may be a difficulty in securing a particular breed, that I should mention a splendid substitute for these two breeds above mentioned. That is the old English Game (low-set breeds, not the so-called modern leggy black reds which have legs like Pelicans), and the Buff Orpington. Hens from this cross will produce almost similar results, and will lay larger quantities of eggs. All birds of these heavy breeds should be hatched early—July, August, and September, and not later than the middle of October for best results. They will be fit for either local or home markets. Always remember that late chicks are splendid subjects for disease, such as roup and chicken pox. My own experience has been that the early chicks grow like the spring grass, while the late ones are wasters.

Chickens for market at twelve weeks old, should be placed in fattening-off pens for four weeks, and fed on the following meal:—five parts barley meal, two parts pollard, one part animal meal, adding skim milk. Feed twice daily, at first moderately. Afterwards give two good meals daily. For the first three weeks give a small quantity of green food at midday. The last week give a good supply of milk in mash. Do not give any hard food while fattening. One and a half to two lbs. added weight may thus be gained, and will pay you double the cost of food and labour.

WHY EARLY CHICKS THRIVE.

It should be remembered that the first three dozen eggs laid by the selected hen produce the strongest embryo germs. Therefore it follows that you have stronger and bigger chicks. On the other hand, the latter part of the season, when the breeding pen has been kept going, not only does the hen feel the strain of continued laying, but the male bird has gone off, often with the result of infertility. Even the eggs that are fertile at this time, usually produce chicks with no stamina, and very often after about four weeks they begin to droop and soon die off.



WHITE LEGHORN. A TYPICAL LAYER.

I have now given you egg-producing breeds for the northern and southern parts, and I have endeavoured to show, by actual test, a grand all-round farm fowl, also the best breeds suitable for home market, producing white legs and flesh, so desired by the English connoisseur of table fowls.

I have purposely omitted many other breeds, having dark legs and flesh, and others with yellow legs and flesh, knowing that the requirements of the English markets are for white, clean-legged, and low-set birds, with white flesh. One of England's greatest authorities on agricultural matters, Professor Long, recently stated in the *London Daily Mail*, "What we want from the colonies in January, February, and March are birds of the Game Dorking. These will command good prices."

WHAT TO AVOID.

For table breeding, avoid all leggy, feathered legged, heavy feathered breeds of the Cochin type, and also heavy combed fowls. Buyers do not require too much feather, long limbs, or big heavy combs. They are useless, and cost much more to produce.

What to Feed and How to Feed.

Next in importance to having healthy stud birds, the most important part of breeding poultry for profit is the feeding. It will be understood that the selected stock from which the farm stock are to come are kept in the pen already referred to. Then it follows that those birds living confined in this 100 by 25 feet run can be expected to secure but very little natural food, hence it is necessary that they should have your best attention.

The principles upon which the science of a balanced ration are based are, I am pleased to say, becoming better understood. The natural food for the fowl is not grain so much as insect life and vegetable matter. Grain is not a ration by itself to produce eggs, feather, bone, or flesh. The stud birds must have what, by nature, is lacking, if we expect the hens to produce eggs and flesh in abundance. Insect life is absolutely the best egg producer a fowl can have, providing good green grass and vegetables are in plenty. If, then, this is the case, a substitute for insect life must be given to the penned birds, and nothing is more easily obtained in this State than the despised rabbit. Failing this, sheep's or bullock's liver, boiled slowly.

The ration for heavy breeds should consist of two parts pollard and one of bran. To this add the rabbit, or liver, lightly boiled, and put through a mincer, or cut up small. The soup from this may be utilized in mixing the whole. This must be mixed to a crumbly consistency, not sticky. Add 10-15 per cent. of raw vegetables, such as cabbage, lettuce, beet, clover, or lucerne. At least twice a week, when available at fair prices, give 10 per cent. raw onion, chopped small. This then contains all the requisites for making bone, flesh, feather, and for egg producing. It must be distinctly understood that crushed oyster shell and sharp grit, in the shape of broken crockery, smashed up to the size of a small glove button, should be available at all times.

QUANTITY TO EACH HEN.

My own experience has conclusively proved that in feeding at least half an ounce of food is required daily to each 1 lb. live weight. This amount, properly balanced, should consist of 1 to 2 ozs. of animal food daily. For example, to the Hamburg of 4 lbs. weight, 1 oz. of the food given should be rabbit, liver, or any meat scraps. To the Dorking of 8 to 10 lbs. weight, give 2 to 2½ ozs. of animal food. Personally I am a believer in giving the best and most nitrogenous ration first thing in the morning. The idea of feeding grain in the early morning is a great fallacy. Fowls require a stimulating meal first thing, a meal which will nourish the body almost immediately, and this the grain does not do.

WORK OF CRAW AND GIZZARD.

The food remains in the first stomach, commonly called the crop, until it receives certain juices, which prepare the food to pass out into the second stomach, or gizzard, where it remains until ground up, and from whence it passes through the body. The rest passes through the intestines, and is found in the droppings. Soft food given early nourishes early, because it does not remain any length of time in either organ.

Grain remains a considerable time in the fowl's craw. It must become soft before it passes through the gizzard. My own experience has been that in feeding on grain in the morning, and again at night, it was only a matter of a few days when the birds had gone completely off their appetite, and left the evening meal almost untouched. In two cases, I had to starve for a couple of days, birds whose digestive organs had been severely taxed by the foolishness of my test. Yet the end I had in view was accomplished, *i.e.*, which was the better method of feeding? I am quite convinced that a grain diet alone is an actual danger, and, further, that by itself it lacks the elements of egg production. There is, roughly speaking, in half an ounce of wheat only sufficient protein to make an egg in four days. It also contains far more carbohydrates, *i.e.*, fats and starches, than are required in an egg. Therefore, grain is lacking in the elements which make the egg, *i.e.*, protein. We see the great necessity of a mixed diet if we expect the hen to produce eggs in abundance.

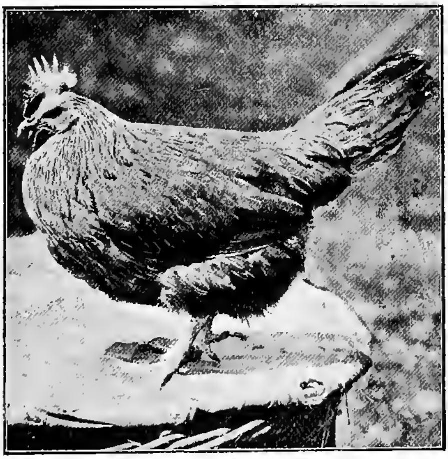
You feed the hen and she feeds the egg, and the egg feeds the germ. But this cannot be accomplished if the hen is fed on a one-sided ration, such as grain. Infertility of eggs is caused by the omission of a proper diet.

WHY CHICKS DIE IN SHELL.

Numbers of people have brought eggs to me which had been incubated but not hatched. Sometimes the chicks are almost fully developed. Others have died in the early stages. On inquiring how they had fed their stud stock, I found invariably that no animal food had been given, also not enough green food and vegetables. These, which are so rich in protein and mineral salts, are absolutely essential to the development of the embryo chick. Many make the remark that it is too much trouble to buy meat and vegetables and to have to chop them up. My reply to these is—Do not touch poultry farming. Fowls require an intelligent and thoughtful owner. In lazy hands they never pay, and never will. Do not keep poultry at all if you dislike them. The successful poultry keepers are those who are fond of their flock, and who find it a pleasure to attend to their wants. A few more hints must be added here regarding the evening meal.

OATS AN EGG PRODUCER.

Last year I made certain experiments in regard to feeding for egg production. Six pullets were placed in separate pens of 75 x 20 feet, with good grass and plenty of shade. In the morning, they were fed on two parts pollard and one part bran, with finely cut rye grass. The afternoon meal consisted of one ounce of wheat to each—no animal food. Another six pullets of same breed, age, and stock were penned under similar conditions, but the ration was altered to two parts pollard, one part bran, sheep's liver, lightly boiled and cut finely, with 10 per cent. chopped raw



PURE SILVER DORKING.
Age, 3 yrs. 9 mos. Record, 615 Eggs.

onion, all mixed to a crumbly consistency, and given in the morning. The evening meal was 1½ oz. of short stout oats to each bird. Ample shell-forming material was provided to both lots. Those fed with the addition of liver, onions, and oats, instead of grass and wheat, produced more than double the quantity of eggs of the first pen. The additional cost was more than compensated by the increased egg yield. This shows clearly that 1½ oz. of animal food daily, with short oats at night, fed to the heavy breeds contain the elements required in developing the ovarian cluster. The eggs are there, why not feed for their development, instead of waiting six or seven years for, say, 600 eggs from a layer when proper feeding will reduce the number of years by at least half. If this is done, and the three-year-old fowl got rid of, good profit will accrue. As an American fancier puts it, "the hen is merely a machine by which she converts one form of food into another," *i.e.*, eggs and flesh. In concluding my remarks on feeding, I should advise feeding not only the breeding pen, but the farm stock layers on short white oats, say, four days a week alternately with wheat. Avoid feeding on maize; it is too heating and too fattening for laying hens when penned up, except in extreme cold and wet weather. Then a feed of maize will be found very beneficial. Remember that short oats will produce eggs and give whiteness of flesh, while maize and wheat will darken the flesh, and both are lacking in lime, as compared with oats. You will have no liver troubles amongst your poultry if you feed on short oats at night. But wheat and maize given in excess are factors favoring liver disease.

Incubation.

The vast majority of Victorian farmers still adhere to the old system of hatching by hens. They are content to hatch 50 or 100 in the year, and very often they have to wait for broody hens, and as a consequence they have late chicks. I would rather have 25 early (August or September) chickens than 150 hatched late (December or January). The early chicks always have good constitutions, feather quickly, and lay early. The late batch usually dwindle down in numbers, and are twice as long in developing, consequently the cost of feeding is double the amount it ought to be.

BROODY HENS.

Your first year is the most troublesome one. You must buy or borrow your broody hen, and care is necessary in doing so. See that the yard from which they come has no disease in it, otherwise you may repent. Observe also that the hen has two wings, in some cases the hen has a cut wing and she cannot be expected to cover the dozen of eggs if her wing feathers are gone. Many chicks die in the shell by this means, the eggs which have been nearest the breast may be incubating splendidly for a time; but as the hen moves and turns the eggs about daily, it follows that the eggs which are near the front, get their turn of shuffling, and are at times on the outside, and should they happen to be on the side of the cut wing, a portion of the eggs is exposed. This is not conducive to good hatching, on the contrary, hundreds of chicks during the course of development die in the shell, and the fancier, from whom the eggs were bought, is blamed for doctoring the eggs. I am not such a cynic as to think that this is a common practice amongst fanciers. It is nothing of the kind. The Victorian poultry fanciers strive to please the farmers. It does not pay to lose custom. Nothing but business ruin would result if such practices as are supposed to exist, such as that of dipping the eggs in hot water, were continued.

The usual custom with all breeders is to guarantee eight or ten eggs, and, in many cases, they even replace infertile eggs. I am sorry to have to say that many farmers will not take the trouble to return the infertile eggs. They more often accuse the vendor of sharp practice, and write a scathing letter; it takes two to make a deal. Now, when the given time (21 days) is up, and only three or four chicks have made their exit, just drop a line to the breeder, and send him back the unhatched eggs. He will treat you fairly. Remember that it may have been your fault, especially if your hen's wings were cut, or if you have used an old hen eight years old, with a low temperature, or a hen covered with vermin. All these items should be strictly observed. I have said that the first year you must either buy or borrow. Do so at the right time, as early as possible, and not later than the first of October. You will then have early brooders the following season. A good plan to make your pullets become broody, is, after they have laid 25 to 30 eggs, to replace each egg you take away, by putting a china or stale egg in the nest. When she finds her nest too much for her, she is usually encouraged to remain on the nest overnight, and thus she becomes broody. I have succeeded by this means for many years, and have found that the old idea of sitting only the old experienced hen is a fallacy.

TEMPERATURE OF HEN'S BODY.

The older the hen, the more reduced her temperature becomes. I have made tests, and have found that a hen 7½ years old, which I had used as a broody hen, lacked the necessary temperature—103 degrees. I found by placing a thermometer under the wing that she only registered 98 deg. F. —too low for successful hatching. On the other hand, I tried a pullet on the same evening (the eggs had been under both hens for 5 days), the younger bird's temperature was a point above 103 deg.

Great care is necessary in removing a pullet, which you desire to sit. Do it at night time. Do not venture to carry her in a bag, and to ride a couple of miles with her on a bicycle. Place her carefully in a basket, with some straw, and some nest eggs. When she feels she has eggs she is more contented. Remove her in the dark, and very gently stroke or rub her breast. Then place her on the nest of eggs, or for a day or two on bad eggs to try her. Shut her out from the sight of other hens, and coax her off in a couple of days. Have a piece of wire netting encircling her coop, and she will soon accustom herself to her new condition.

MAKING THE NEST.

Avoid wooden floors to nest. Remove the bottom of box, and make nest on ground, basin shape. Place ample dry pine needles or dry grass, especially when the earth is very damp. Should you use dry earth in shed, place first a little green fresh grass and a layer of dry grass on top. This will cause moisture, and will aid the proper development of the embryo chick. In dry climates it is well to allow the hen a damp dust bath. She will find it out, if left within her reach, and it will answer a double purpose, *i.e.*, will keep her feathers damp, and will prevent the vermin trouble.

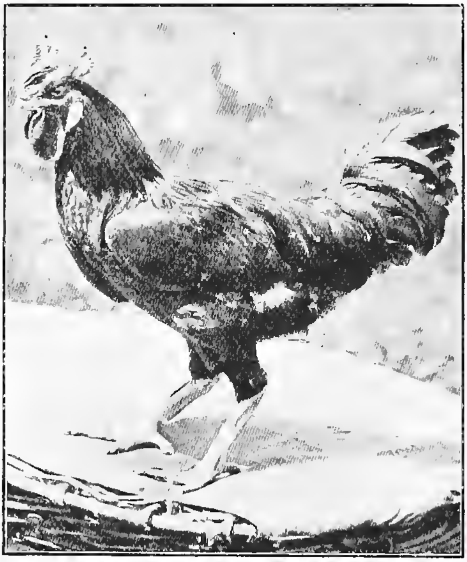
CARE ON NINETEENTH DAY.

Nineteen days after the hen has set she should have her best meal, consisting of hard grain. Maize is good, and is heating for sitting hens—and a little chopped meat. While she is thus engaged feeding, carefully remove the eggs, and also the nest, which must be burnt, and replaced by a new one. This will be a kindness to the hen, and a great help to the chicks, because the nest may be filled with vermin, and when the chick chips the shell, these mites are soon active, and reach the inlet, and destroy the chicks. I have known chicks to be hatched quite blind by this pest getting into the shell. They require all their vitality to struggle out of the shell casement —hence the importance of clean nests.

HOW TO FEED THE CHICKENS.

Chickens require no food for thirty hours after hatching, as nature, prior to hatching, has provided them with sufficient nourishment for almost two days. The yolk, which has diminished but slightly, is taken up by the navel, is absorbed, and becomes the food for the newly hatched chick. This is also its food during the time of incubation. This is a wise provision of nature.

The chicks' first food should consist of that which approaches as nearly as possible the natural absorbed yolk, that is, egg, boiled hard, and mixed with stale bread crumbs, slightly moistened with milk—not sloppy, but crumbly. Give this for the first three days, a little at a time, but often. Do not allow the food to lie about and become sour. Use judgment. After three days add to above a little fine oatmeal, moistened with warm milk, and still feed sparingly but often. The second week the meal may consist of oatmeal moistened with milk, a pinch or two of dry bone-meal, a little powdered charcoal, and fine grit, and some pulped-up raw onion. Give during the second week, white millet seed at night time. This they can manage, and it will prepare their organs for the still harder grains which follow. Do not give any bran, meat, or green bone for the first three weeks, as these irritate the bowels, and cause diarrhœa. When chicks are starting their fourth week, the diet may be changed slightly. You may then use 1 part oatmeal, 1 part bran, ½ pollard, and the other ½ portion (making 3 parts in all) should consist of lightly-boiled sheep's liver, using the soup



FIRST CROSS, BUFF ORPINGTON AND INDIAN GAME.

from this to mix the whole, and some finely minced raw onion. These ingredients will furnish bone, flesh, and feather. The last meal at night should now consist of crushed wheat and hulled short oats, alternately or mixed together. Fresh water, and occasionally skim or pure milk, should be supplied night and morning, and kept out of the sun, otherwise bowel trouble may follow. From the fourth week the meal should be similar to that of the adult birds, but with the addition of bone-meal—a cupful to 30 chicks, and a fair quantity of animal food, unless there is abundant insect life available, and very much depends on locality and size of run. Do not forget that the frame of the chick wants building up, therefore bone-meal is of great importance. It is a mistake to put on too much fat to young birds. When the frame is built it is ready to carry the flesh.

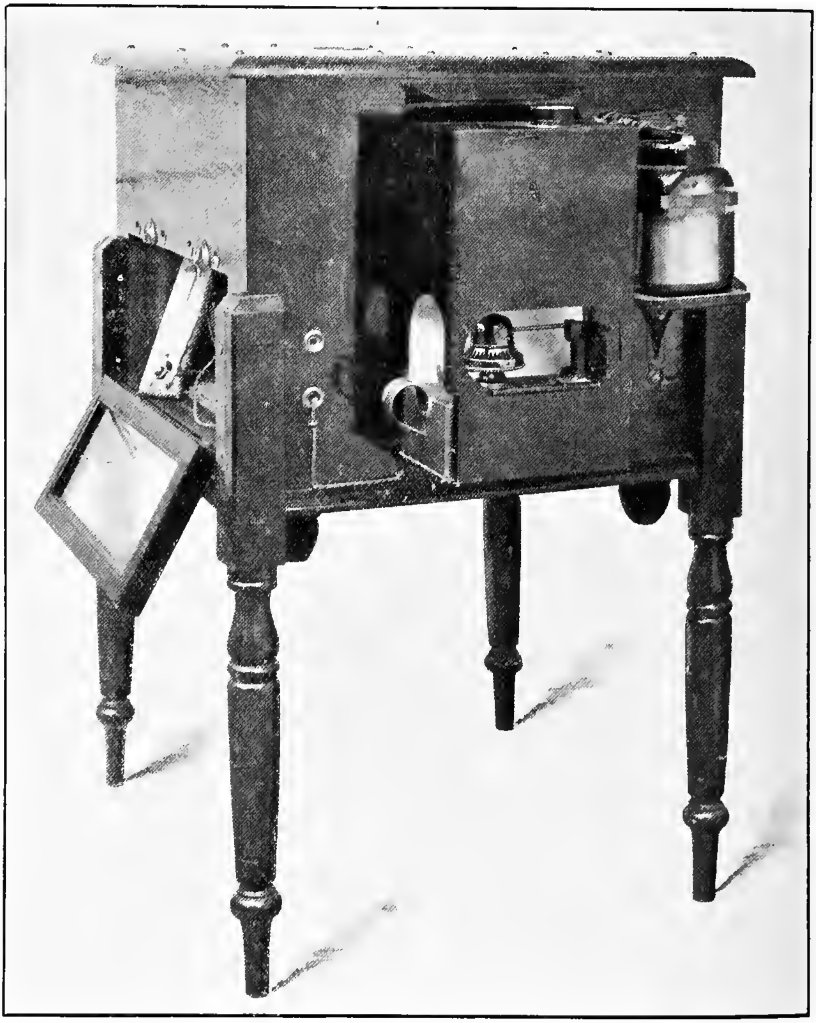
HOUSING THE CHICKENS.

The first ten days of a chicken's life is a matter of great concern to the breeder. Many make the mistake of allowing the hen to run her chicks off their legs—first one toddles in the rear with wings down, then another. The fault is in allowing the hen freedom. She should be kept in a fair sized coop, one of my own design is shown, having strong wires running up and down in front, so that the hen may get her head through, and have plenty of fresh air. The chicks, too, are able to run in and out at will. Avoid a wire netting front, it is the cause of roach backs and crooked breasts, and often broken wings. As the chick grows, the wire mesh becomes too small, and in pushing their way in and out it becomes a source of danger to them, therefore it is safer to have strong wire or battens, arranged vertically, leaving ample space for the chickens, and only just sufficient to keep the hen inside. The wire attachment to coop answers a double purpose. It prevents cats and rats or hawks and crows from taking off the chicks, and if the coop and wire run are moved to fresh ground occasionally, the development of the flock will be rapid. Later, when the youngsters are older and stronger, and you do not require to confine them to small space, the wire run may be dispensed with, and the little chicks will commence to travel round with their mother. Great care should be taken when you have a number of hens with chicks, to keep each lot distant from the other. Otherwise one of another batch may get into the wrong coop, with disastrous results. I have said quite enough about the natural way of hatching, but to the farmer of large poultry products I would strongly urge the use of artificial means for hatching and mothering.

INCUBATORS.

When your mind is made up to breed 1,000 chicks, then it is time to look around for the best incubators you can find—not the cheapest, but the best. More time and money are wasted with inferior incubators than some of you know. There are many good machines now on the market, some of them being made in Victoria, and I fail to see why we should purchase foreign makes, when at our own door, we find splendidly-made and reliable incubators. I have no hesitation in classing the Australian machines with those of foreign manufacture.

At the present time we have in this State a patent regulator for incubators, called Law's Electric Regulator for Incubators, whereby artificial incubation may be made ever so much easier, both to the farmer and to the raw amateur. This may be fitted to any good machine now in use, or, perhaps, a machine which has been laid aside owing to the numerous intricacies met with in some makes. The advantages of Law's patent regulator are many, and the principles underlying its construction and design are correct both from a mechanical and scientific standpoint, while from practical and also economic consideration its simplicity, rapidity of working, and efficiency, speak for itself. The temperature of all incubators is indicated by means of a thermometer, then by certain mechanical arrangements, quite independent of the thermometer, the heat applied to the eggs in the drawer is diminished, either by reducing the flame, or allowing it to escape when the machine has attained a certain temperature. But, as all these mechanical devices are far from satisfactory and reliable, the inventor has made the thermometer the absolute controller of the heat, the arrangement being such that the thermometer not only indicates the temperature, but also, at



INCUBATOR WITH LAW'S PATENT ELECTRIC REGULATOR.

a given point (103 deg. F., which is the limit of safety), reduces at once the supply of heat. This is done in a simple and extremely rapid method by utilizing an electric current, acting on an ordinary electric magnet, placed in such a way that the flame of the lamp, which supplies the heat, is largely reduced, and consequently causes a correspondingly small quantity of warmth to be carried to the eggs. The time for this is not a matter of minutes, nor yet seconds, it is instantaneous, and without doubt is absolutely certain. Immediately the temperature has risen to the utmost limit for safe working, the mercury of the thermometer completes the electric current by which this is brought about. The principles of this Victorian patent are entirely different from any other existing system. The devices for regulating incubators, up to last season, were many, and oftentimes complicated, *i.e.*, lever weights, capsules (in some cases thermostats), dampers, and rods. In a word, Law's Electric Regulator is controlled by the thermometer itself, apart from any other device. It not only shows the heat in the egg drawer, but controls that heat by regulating the supply conveyed thereto by electricity. The electricity required to do the work is furnished by an ordinary bell battery of one cell only, commonly called a Leclanche battery—or, if preferred, a dry cell may be used, of which there are many thoroughly trustworthy kinds to be had that will last for years. They do not emit fumes, nor is their presence likely, in any way, to be injurious to the eggs incubating. A great feature with this patent is that the consumption of oil is less than half of that used with any other machine. I can commend its use to all those who wish to secure good results. In a word, it will revolutionize artificial incubation.

WHERE TO PLACE INCUBATOR.

The incubator should be placed in a room where the temperature will be as even as possible, and where proper ventilation can be had without having a draught on the machine. A good plan is to dig a cellar 3 or 4 feet deep in the ground. Build a shed over same, and place the incubator in the solid basement, allowing the ventilation to come from the top near the roof, so that no draught may interfere with the lamp flame. A steady light is important. Always test your machine for two or three days, and follow the directions sent by the maker, and when it runs at 103 deg., and keeps at such, then start it going with the eggs you wish to incubate. Turn the eggs daily, but do not open drawer when eggs are chipping.

BROODER HOUSES.

Chickens hatched by machine must necessarily have a foster mother. If hens are available so much the better. When your incubators are full, encourage hens to sit on either fertile or stale eggs, then these hens can be utilized, and will take the artificially hatched chicks. Give them to her at night time. If you cannot do this, you should have a brooder house, which may be had from many firms now advertising in the weekly papers. The cost of same ranges from 50s. upwards. The temperature required the first week is as near 90 degrees as possible—better lower than higher—and each week reduce the temperature, gradually. Do not over-crowd, and place some clean sand on floor. Full particulars are sent with brooders. In the case of a hen dying, a good and safe foster mother may be found by utilizing a large stone bottle, wrapped well in flannel, and stitched on, filled with hot water, and placed in a snug box lying on its side, securely corked and wedged to prevent rolling. Fill three times daily, and last thing at night. I have saved many chickens by this means—gradually hardening the little orphans until they grow strong enough to do without the bottle.

A CHEAP BROODER.

Another good plan is to cut up an old woollen hearthrug, cut into strips and tacked on top roof of an ordinary case, about half-an-inch apart; little or no heat is required when this is available. I am not a believer in coddling chicks by artificial heat. Leg and bowel troubles are often caused by an overheated brooder. I have reared hundreds of pure stock without the aid of any fancy or expensive brooders. The woollen rug is what they like to feel dangling over their heads—providing always there is no draught, but a fair amount of ventilation.

Care is necessary during windy and wet weather. More chicks, artificially hatched, die through this than anything else. Shelter from both is an absolute necessity, and so is a dry floor. Do not encourage chicks to crowd into corners together, it is the cause of crooked tails. Do not permit them to roost on the edge of a box, as many do. The little breast bone is very soft, and gradually it will become quite crooked if the young birds are allowed to roost in this way, and this is a decided fault in a table fowl. Keep them on floors covered with plenty of clean dry grass or pinus insignus leaves. They need to bend their toes to grip at something. Hard floors cause the toes and nails to grow crooked, and you do not want to have a lot of deformed chicks. These little items should be noted, as they are all important, and will lead to greater success.

Diseases, their Cause and Cure.

Unless a fowl is valuable from a breeding point of view, the question is, does it pay to doctor? which with time and drugs often costs more than double the value of the affected bird. In very bad cases the best remedy is the axe, and burning of the body. Should a valuable stud bird go wrong, by all means persevere with such one. Try to discover first the cause. Possibly it may be a crack in the house, causing a draught, or a badly-ventilated damp or unclean crowded house may have caused the trouble. Rectify the error, and isolate the sick one, to prevent contagion to others.

Every poultry farmer should erect a suitable shed in an out-of-the-way corner, distant from all other birds, and build facing the north-east, so that as much sun as possible may reach it. The front should consist of a glass frame, with ventilation at top, closed well round at foot, to prevent birds from throwing out, by scratching, the germs of disease. The hospital should be kept clean, and all droppings and feathers burnt, and afterwards buried. Disinfect well with phenyle, Condy's fluid, or a carbolic solution. A syringe should be kept for the purpose.

CARING FOR SICK FOWLS.

After isolating, give a nourishing meal. The soft food given in the mornings to the other birds will be the best. Always feed the sick fowls on soft food morning and night, but avoid all grains. A raw egg beaten up with a teaspoonful of brandy will often save a fowl's life. In giving liquids of any kind, use a spoon, which should be kept for the purpose, and take great care to place the spoon over the top of the tongue, so that the liquid passes down the right channel. Carelessness in this may choke the bird. Many may make the remark, "I have not time." To all such I again repeat, do not go into this business, for it takes time to do a thing well. When a bird dies, make an intelligent examination, and learn something by it. It will often pay to lose one bird, if you can save a whole flock by that experience.

PRIMARY CAUSE OF DISEASES.

These are:—

1st. Unhealthy surroundings.
2nd. In-breeding.
3rd. Breeding from birds hatched out of season (which are usually wasters).
4th. Careless feeding of the parent birds in the breeding pens. Example: Pollard and potatoes will not produce a strong embryo chick.
5th. Hatching out of season.
6th. Setting every egg laid in the breeding pens.

The second season hens' first forty eggs produce the strong embryo germs, while those laid later, say in November, December, and January, are those eggs I would advise you to sell for market purposes. Breed only from the best, in every sense of the word, and disease will be almost unknown to you.

REMEDIES.

Always be prepared for emergencies with a thoroughly equipped medicine chest, containing:—

Epsom Salts, a safe aperient in cases of roup, one packet to a quart of water.

Chlorodyne, for severe cases of diarrhœa, or whitish-green discharge from vent, with tail drooping. Give seven drops on piece of bread three times a day.

Quinine Sulphate, for roup, half a grain mixed with half a raw egg, a teaspoonful of whisky or brandy, and two drops of eucalyptus oil, twice a day.

Linseed Oil, a teaspoonful to an adult bird twice a day for catarrhal affection.

Vaseline, applied in cases of accident to comb and feet when cut through birds quarrelling.

Boracic Acid, diluted in warm water for inflamed eyes. Dry with soft rag after bathing eyes.

Kerosene, for cleansing nostrils and mouth when affected with roup—a safe and sure death to germ or insect life.

Iodine, for sprains, &c.

Sulphur—Eucalyptus Oil—Carbolic Acid.—These, mixed well together, say, a dessertspoonful sulphur, three drops eucalyptus oil, and two drops carbolic acid, are applied to chicken-pox marks, or fowl warts, usually found on comb and eyes of young birds.

Keep medicines away from children's reach, on a high shelf, as some are deadly poison.

CHICKEN POX OR FOWL WARTS.

This usually makes its appearance in the autumn, and affects principally the young stock. The first symptoms are loss of appetite, dullness, and an excessive thirst. The first thing necessary is to isolate and keep birds away from water for two days, giving a little milk. The more water they drink the greater the fever becomes. In about three days, small yellowish warts may be seen on comb and head. Give the tonic (sulphuric acid and sulphate iron), called Douglas's mixture. Then make an ointment of sulphur, sufficient to half fill a pill-box, three or four drops eucalyptus oil, two drops carbolic acid, and a little sweet oil or vaseline. Mix up well, and apply to affected parts. Should warts appear on the eyelids, do not allow the eyes to close, or seal up, but apply freely glycerine, and when the warts appear to develop on the lids, anoint carefully and regularly with the above mixture. Should you neglect the eye, you will have serious trouble. If it is allowed to seal up, the inflammation is sealed also, and the ball of the eye becomes much swollen, and often a growth forms behind the eye, resulting in its loss. I had a case of this brought under my notice at one of the agricultural classes for farmers. The eye simply stood out of the socket to the size of a large cherry. The growth had eaten into the eye-ball. I promptly removed the eye, and thus saved the bird's life and one eye. Dozens of neglected cases similar to this have been brought to me, and I have treated them in the same way. Damp, stuffy, unclean houses are the primary causes. I have never known a single instance where a bird has had a second attack of chicken pox. Feed affected bird always on soft food, with plenty of raw chopped onion, which is in itself a splendid blood purifier.

ROUP.

Roup is usually the result of a neglected cold. The first symptoms are watery discharge, throwing off an unpleasant smell, from the eyes and nostrils. This odour is an easy means of detecting roup. Those most subject to it are the late hatched chicks. In severe cases the eyes become very much inflamed, and a cheesy growth forms in the roof of the mouth. It sometimes extends to the back of the eye. Bad cases are very hard and tedious to cure, and unless a bird is of more than the average value, use the axe, and burn the body. Do not attempt to breed from any bird that has had roup. Isolate at once all cases of this kind, and feed on soft nourishing food, consisting of a little pollard, bran, egg, and milk; onion, and occasionally a little meat. Avoid grains entirely. The nostrils and mouth should be thoroughly washed with a feather dipped in kerosene. A small syringe will be found even better than a feather for this purpose. Then give the following, morning and night:—Half a raw egg, a teaspoonful whisky or brandy, two drops eucalyptus oil, and grain of sulphate of quinine. Mix these well together. This has proved to be the most satisfactory roup cure I have ever tried. It seems to promote vitality, and reduces the fever at the same time. Wash the head and under-wing feathers with a solution of permanganate of potash.

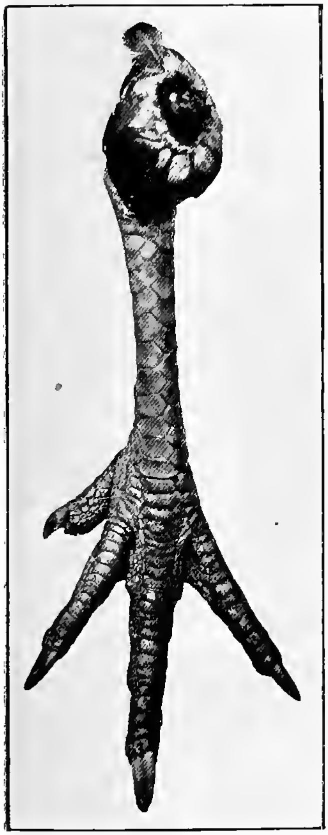
DIPHTHERIC ROUP.

This must not be confounded with roup. The bird suffering from this trouble makes a peculiar noise like a cough, and as it does this the head is thrown forward, with the mouth open, and it looks as if it were going to choke. There is no bad smell arising from throat, and the bird appears to be fairly well, except for the terrible attacks of choking. When these paroxysms occur the comb suddenly darkens.

The treatment recommended is as follows:—Open the mouth, holding the bird away from your own mouth, as this trouble is communicable to human beings. Place your finger under throat, and raise up the windpipe. Should there be a cheesy growth around windpipe, make a V-shaped funnel, and place a very little quantity of lime in this, and blow down. Failing lime, use sulphur. I have had very good results by using a paste consisting of a little sulphur, vaseline, and one drop carbolic acid, thoroughly mixed and applied to the parts with the aid of a piece of thin wood, to which a piece of clean soft rag, like a mop, is attached. Feed on the best and most easily swallowed food, *i.e.*, raw egg, and some oatmeal given soft. It may seem strange to advise eggs for fowls, but I know of nothing that has assisted me greater, in cases of extreme weakness amongst valuable stud birds, than the fowl's own gift, the egg. I usually add a little spirit.

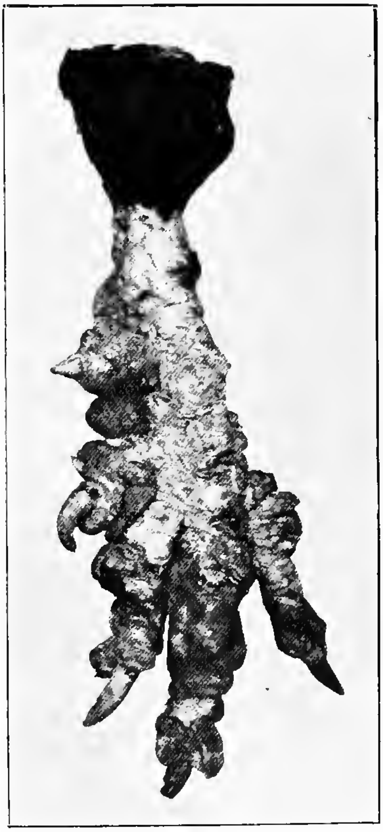
SCALY LEG.

This trouble is caused by a small mite which gets under the scales on the legs, and especially toe joints. These mites stay there and lay innumerable eggs, until the legs become covered, and it is a very ugly sight.



HEALTHY SHANK AND FOOT.

The result of proper attention and treatment.



SCALY LEG.

Brought on by dirty fowl-houses and runs.

Scrub the legs and feet with a hard nail brush and warm water and soft soap, until the scale becomes soft. Then hold the legs in kerosene occasionally. This will destroy the insects, and gradually the legs will improve. A little sulphur and sweet oil rubbed in will also assist in bringing this improvement about quickly.

HEAT APOPLEXY.

This year many fowls have succumbed to heat apoplexy, especially where insufficient shade has been provided. Many people think that any place will do for a fowl run. This is not so. Shelter trees or hedges are as essential as cleanliness and proper food to birds. They cannot live without shade. The symptoms show themselves by a sudden fit of running round and round, as if the head were trying to take hold of the tail. Immediately this is noticed, catch the bird, and if a heavy-combed variety, bleed the head at the base of comb, after which hold head under the tap, and place the bird in a dark basket in a cool place. No food is required by the bird for two days, but a little milk may be given twice a day. On no account allow other fowls to worry the sick one, and gradually a cure, in most cases, is affected. When the fowl is recovering, feed on soft but not heating food. Avoid maize meal and animal food for a time.

POULTRY PARASITES.

There are two classes. First, those that live on the fowl's body, and drain the life out of a bird, and swarm all over a neglected house. They get on the keeper's legs at times, and it is as well they do. It surely should remind him that the syringe has not been used for some time. Second, the red mites, already referred to by me in the *Journal*. These hide under the perches, and in cracks, and are often found where the perches have been nailed. They attack the birds at night, and after having their fill, return to their haunts. In the former case use insectibane, spraying well all over the body of the bird. The red mites can be easily destroyed with a syringe charged with kerosene, phenyle, or carbolic acid solution, say a cupful of either to an ordinary bucket of water. If made weaker than this, some of the vermin may escape. I find kerosene to be the surest destroyer of all fowl parasites, including fowl tick.

Uralite is recommended strongly for building tick-proof houses, and I am gratified to know that many have tried this material with splendid results. Two farmers write informing me that since they have housed their birds under Uralite, they have not lost one. Will others follow their good example, and so assist in stamping out this pest, which if not drastically dealt with, will become a very serious matter in this branch of farm work?

The old method of lime-washing the fowlhouse is not sufficient by itself. Add crude carbolic oil or strong phenyle to the lime wash. Kerosene emulsion is a splendid preparation. Take 1 lb. of hard common soap, and dissolve in a gallon of hot water. While hot, add 2 gallons of kerosene, stir well till cold, after which add 8 to 10 parts of water to one part of the stock. Spray on with a syringe or a brush. Should it clog the syringe, add a little additional water, and stir again.

GAPES.

This is a disease caused by the presence in the windpipe of a small thin red worm, usually described as gape-worm. The symptoms are constant gaping or yawning. It is seldom found in adult birds, and more frequently attacks chicks 4 to 5 months old. Place some air-slacked lime in a barrel, and put the affected bird into it, covering the top over for a minute or two with a piece of hessian, and allow the bird to flap her wings, making a dust, which will find its way down the windpipe. This will prove very effective in removing this trouble.

FEATHER-EATING.

This is even a worse vice than egg-eating. Birds confined in small miserable yards, lacking a variety of foods, especially animal food and vegetables, will pluck the small juicy feathers out of their companion's body, and I have known them to attack themselves, and make parts of their bodies quite bare. The best way to cure this habit is to hang a boiled rabbit or raw sheep's liver up just out of the birds' reach, and let them jump for it. This will supply them with that food which in the moulting season is very necessary to feather making. It will at the same time keep them active.

EGG-EATING.

This habit usually begins by the feeder's neglecting to supply lime food such as is contained in oyster shell, bone meal, and burnt bones, all of which are rich in carbonate and phosphates of lime, so necessary in shell forming. If they once taste the egg, they crave for it. Many remedies have been advised, viz., to collect some stale eggs, and scatter about the yard. The hens will then eat so many that they will get tired of eggs. I have found a better plan is to have special nest boxes, the floor of which is sloped, and directly the egg is laid it rolls to the lower part, where a fair-sized hole is made, and the egg rolls into a small chamber of the box away from the egg-eater, and there remains until gathered by the daily collector. This safety box is also a preventive to other hens who may acquire the troublesome habit of egg-eating.

PORTABLE PENS.

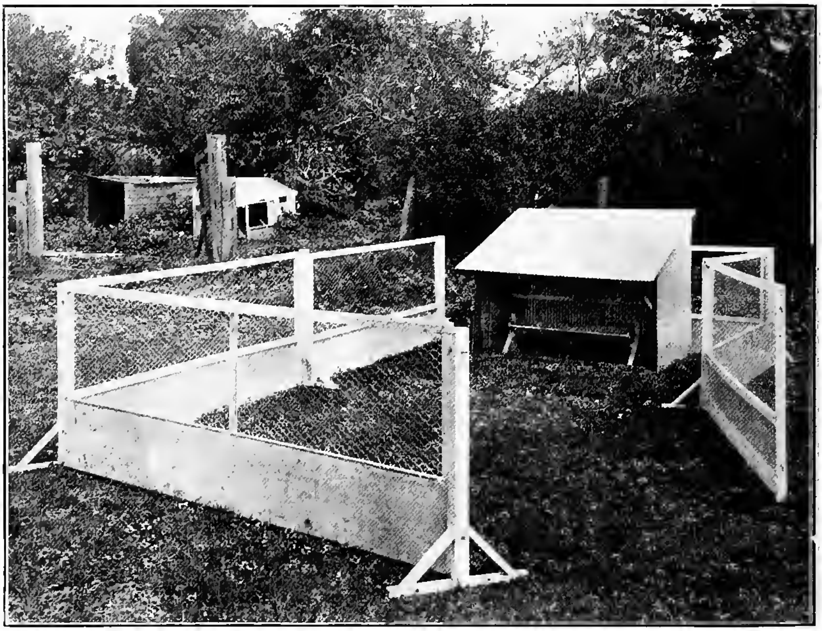
Portable pens, as exhibited by the Department of Agriculture, at the recent Royal Agricultural Show, under my supervision, should be more often adopted. After the farmers have finished cropping, there is always abundance of insect life and fallen grain on the land, and with a few portable runs, with or without wheels, large numbers of birds may from time to time be kept moving, scratching, and manuring at the same time, feeding themselves at the small cost of labour that it entails, also bringing in a fair return.

When I think of the numberless corn-fields in this State, and of the many thousand tons of grain that were shed in those fields at harvest time, and a few months later buried below the surface by the farmer's plough, I consider how many tons of poultry could have been raised on this corn in the past twenty years.

The more new ground fowls can run on the more they scratch for insect life, and most certainly will they assist in ridding the land of wild oats and many troublesome insect pests, which often cause serious loss to the farmers. The illustrations show clearly how to construct houses and movable pens. There is really no necessity to make them 6 feet high, 4 feet will answer, providing light frames are placed across the top; 1½-in. mesh is sufficient to prevent the birds flying out or foxes and the like getting in. The size of these runs does not require to be larger than 24 x 16 feet for twenty birds, providing always they are moved at least once a day; twenty birds kept in such pens will turn over practically every sod, and add fertilizer at the same time. The accompanying plate demonstrates the ease by which the house and hurdles may be taken to pieces. The perch is also portable, and is shown in the foreground, with dropping board, which is 18 inches wide, and is suspended by hooks immediately under perch.

Scattered Field System.

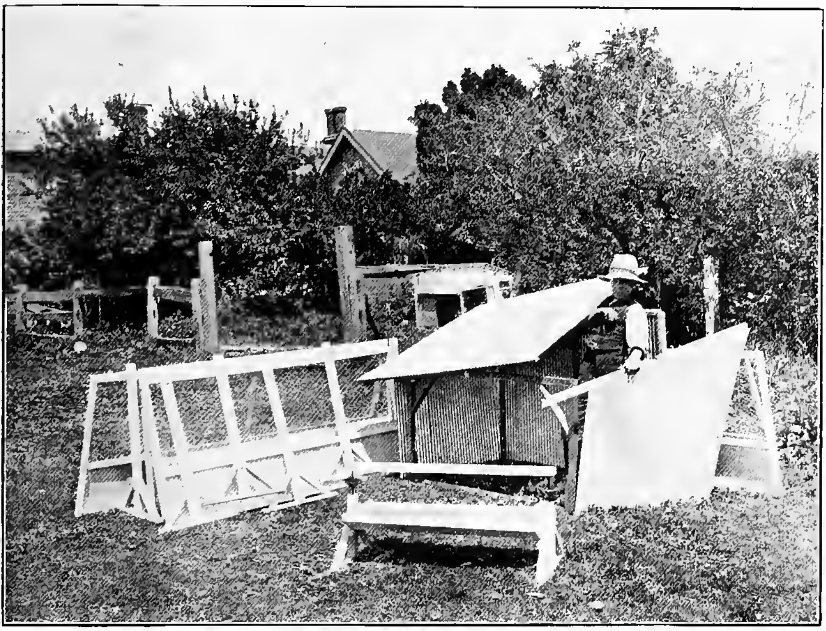
Another good plan is to build portable houses, with strong wire doors, sufficient to accommodate twenty adult birds. When the chicks are old enough to leave the brooder-house, or prior to their leaving the mother hen, place a brood in the field-house, confining them there for a few days to accustom them to their new quarters, and feed twice daily until giving them their freedom. Then, each morning, they should be let out and fed very sparingly; they will get to know you, and answer your call, after which they will find their own food during the rest of the day.



PORTABLE POULTRY PEN.

Mr. Grant, of Pakenham, has adopted this plan with great success. Scattered all over his large orchard may be seen neat white houses, all of the same design, and in each a small flock. Strange as it may seem, few birds venture to leave their own quarters. Mr. Grant informed me that no less than 600 youngsters were reared in this way. The ground is kept scarified all the year, and the birds delight to follow the machine, picking up insects, which are so destructive to fruit trees. The fowls keep down the codlin-moth, and, to use the owner's words, "The orchard feeds the fowls, and the fowls feed the orchard."

Wheat-growers of the north, with a little outlay, could keep 1,000 birds at small cost. When harvesting operations are over, tons of grain are lost, and insects abound, which the birds could secure and thrive on. In England and America many farmers have adopted this scattered-field system. and make £100 to £250 a year from their poultry. All that is required is an enthusiast to take charge, and this, to my mind, is the key to success. It is useless to pay a man to look after fowls if he dislikes them. They require an intelligent and thoughtful caretaker. Northern farmers have grand opportunities to add to their incomes, for if crops are at times partial failures, the fowls will always augment their turnover. There is no finer climate in the world for poultry raising than this. When will the farmers realize it? Are they too well off, or do they lack enterprise? In conclusion, let me urge them to go in largely for Leghorns, 500 of which, by careful selection and breeding, bring in a profit of over £150 per annum for eggs alone. In some parts of the Mallee, this has been, and is still being, accomplished.



PORTABLE POULTRY PEN, SHOWING SECTIONS.

AGRICULTURAL VALUE OF POULTRY MANURE.

I have often wondered, when reading the result of egg-laying competitions, and also when balance-sheets have been sent me from agricultural and college students, why no mention was made of fowl manure. I have never yet seen in any statement of the year's work, what has become of this valuable aid to the farm. If such be the case, one is led to the conclusion that most poultry breeders either neglect gathering the manure daily, or else throw it away into the rubbish heap. When it is remembered that each bird of 8 to 9 lbs. live weight drops nearly 52 lbs. of manure each year at night-time alone, and basing the average daily droppings at nearly 100 lbs. per bird per year, what must the value of this manure, wasted or trodden in yearly, in Victoria amount to?

To get a fairly accurate idea of its value, I have had gathered daily the droppings from four pens, the size of each pen being 75 feet x 25 feet. In two of the pens there were eight birds, in the other two seven, short grass being in each pen. The result was as follows:—From the pens of eight birds—Dorkings, weighing 8 lbs. each—the manure was gathered and partially dried (seven days), the weight from each bird averaging (during day-time), 1½ ozs., and in dropping-board under perch (night-time) 2 ozs., or 46 lbs. per annum. It will thus be seen that the night manure from large birds is worth at least 1s. per annum. This conclusively demonstrates that thousands of tons of fowl manure, representing thousands of pounds sterling, are lost yearly in this State alone.

According to an eminent authority, its true market value is as follows:—

	Fresh Manure.	Partially-dried Manure.
Moisture	61.63	41.06
* Organic matter and ammonia salts ...	20.19	38.19
Tribasic phosphate of lime	2.97	5.13
Magnesia, alkaline salts, &c. ...	2.63	3.13
Insoluble siliceous matter (sand) ...	12.58	12.49
	100.00	100.00
* Containing nitrogen	1.71	3.78
Equal to ammonia	2.09	4.59

Roughly speaking, the fresh manure is worth £2 per ton, and, when dry and properly stored in casks, £4 per ton. It will thus be seen that little, if any, manure from live stock is so rich in fertilizers as the fowl manure.

One thing should be borne in mind, *i.e.*, that lime must on no account be used in the runs, or houses, as lime liberates the ammonia, and when such is the case, its value as a manure is practically gone.

The collected manure should be stored in an old barrel, where it must be kept dry, and mixed with a little sand, or some ashes of burnt weeds, also a little soot. This is excellent to preserve the ammonia. The manure may also be placed in a tub with water, and allowed to stand over-night; then stir and use the liquid for watering. Vegetables of all kinds, also flowers and plants, especially pelargoniums, roses, lemons, &c., do well with it.

The growth of the onion and tomato, &c., is largely increased by the use of this manure, and to nurserymen it is of the greatest value. The vegetable acids are as important as protein to growing chicks, both being an absolute necessity. It is therefore an easy matter where land is available, for every farmer of poultry to utilize to its fullest extent the valuable manure referred to in growing vegetables.

DUCKS FOR PROFIT.

To the cottager and farmer alike, money can be, and is, being, made by those who have gone into this profitable industry. The production of high-class market ducks has grown to be a business of great importance, and the indications point to rapid development. One can scarcely realize that the duck business, as seen to-day, especially in the United States, has grown up within 30 years. As the consuming public becomes more acquainted with the attractive and delicate dish that the duck offers, the demand will rapidly increase. This business will develop by leaps and bounds for many years to come, and as the profits are decidedly good, and the returns so immediate, it is not unlikely that many farmers and others will turn their attention to producing young ducks for market.

Very many of my students—some of whom have had but little capital to start with—have asked me this question: "Which will bring the quickest return, fowls or ducks?" To such I reply: "Ducks." With ducks one has only to wait 10 to 11 weeks for them to develop sufficiently for market purposes. It must be understood that the stock should be selected both for size and egg production. It would be utter folly to breed from, what was termed years ago, puddlers weighing 3 to 4 lbs. live weight. First purchase large well-formed stock, two years old for preference, and the drake should never be less than 9 months and *unrelated.* This is the class of stud birds which will produce large and quick-maturing ducklings weighing, when 10 to 12 weeks old, 12 to 13 lbs. a pair. Should you have only young ducks, then secure an older drake, unrelated. Of course, much depends upon the feeding, and ducks require forcing to get them up to this weight. If the ducklings are scantily fed, they will be stunted in growth, and at 10 weeks would not weigh 8 lbs. a pair. This is an important item, for after 11 weeks the youngsters commence to throw off the downy feathers, and then the growth is checked immediately. The food given for the next four weeks is usually converted into the adult feather at the expense of the body, and much of the profit is lost. Keep them growing as fast as you can, so as to secure the desired size, before the change of youthful feathers gives place to what we term the adult quill feathers. It is also important to note that the poulterer prefers to pluck the young feathers, as being much easier, and there is less likelihood of tearing the skin. Nothing is more annoying to the poultry dresser than to have to struggle in pulling the heavy quill feathers.

Locality.

One of the most important items in connexion with duck farming is the site selected. In this respect one could follow on the plan laid down in the article which deals with fowls, and although ducks can stand crowding far better than fowls, yet the higher and more sloping the land is, the better. Sandy soil is much more suitable for ducks than hard land. Above all, avoid the spot that has too many stones. I have taken particular notice of this, and in some parts of Victoria, especially in and around Bendigo, many ducks die through feet troubles. They are subject to bumble feet, as are fowls, and many make the serious error of keeping valuable ducks in a yard or pen surrounded by Box thorn, whose thorns, continually dropping to the ground, are very dangerous to ducks. Recently I had occasion to visit many duck yards, where the Box thorn hedge was prominent. Invariably I was requested to examine ducks suffering with feet troubles, and in nearly every case I discovered, in the ball of the foot, a thorn, and with much difficulty extracted it. Some of these thorns were half an inch long. Ducks' feet are much more tender than fowls', and operations on ducks are not always successful.

Housing.

Ducks should not be confined in warm or ill-ventilated houses; they require, above all, a dry floor. Concrete, bricks, or asphalt, will make good serviceable floors, which are easily cleaned, but a dry bed is very necessary. This can be made of either straw, *Pinus insignis* needles, dry grass, or dry stable manure. Three sides to the house, and a sound roof, are all that are required, leaving, for preference, the eastern side entirely open, and allowing say six inches, for ventilation, on the top near roof. A floor space of about 8 by 6 feet is ample for 25 fully grown ducks. When the bedding becomes damp, remove it, and replace by dry. Ducks artificially reared are subject to cramp, and more are killed annually by this complaint than from any other cause, except perhaps in-breeding, hence the necessity of having dry floors.

Shelter.

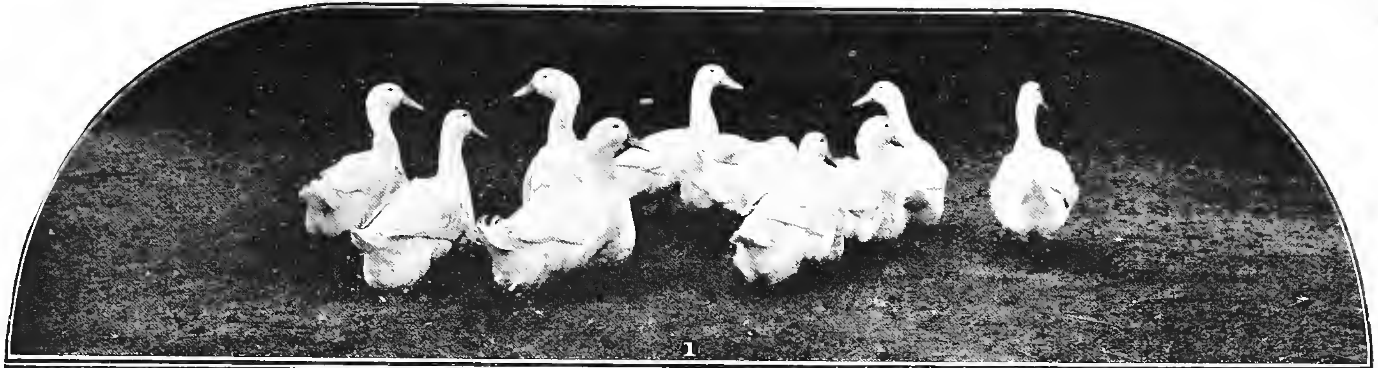
Admitting that the Box thorn acts as a good shelter, I think it inadvisable to use it, as it causes so much trouble with the birds' feet. There are many other trees which grow more quickly, and also provide green food when grass is scarce. The saltbush makes splendid shelter, and is a great relish to the meal. It grows in the poorest land, and in the dry areas of the north it can be grown to advantage. There is nothing so healthy for fowls or ducks as the saltbush, and there is no necessity to add any salt to the morning mash when this is available. I may here mention that the most successful duck breeder in Australia (Mr. P. Briggs, of South Brighton) has a fine hedge of saltbush, which, to use his own words, " is worth pounds a year," in that it keeps his ducks in splendid health and condition, and acts as a good shade. He also grows a patch of maize, which is cut up finely, and mixed in the mash. Those who have the tree lucerne, *Tagasaste*, would do well to plant same around the duck pens, keeping the tops well cut, and utilizing these finely chopped in the morning meal. That ducks require shade goes without saying: nothing kills them quicker than exposure to the glaring hot sun.

Number of Ducks in Pen.

It is now an established fact that ducks do best in lots of 25, as they have a better chance of securing their fair share of the mash. Fifty ducks together will not usually produce as many eggs as twenty-five will, and therefore it pays better to provide a number of pens, and have small batches, than it does to feed 100 in a flock. This only applies to egg production, but not for breeding purposes, as I shall mention further on. As an instance of over-crowding, I had occasion to visit a very large Runner-duck farm, carried on by Mr. Wall, at North Brighton. In all he showed me 1,000 Runners, and I put the question to him: " Do you find the pens containing 200 ducks in each, produce an average egg yield equal to the pen containing only 25 birds?" His reply was, " The best average yield comes from the pens containing only a few birds." He further remarked that he was then considering the desirability of subdividing the large pens into several smaller ones. There is no question that ducks, like fowls, do better in small numbers, and yield a greater profit, which more than compensates for the extra cost of labour and material. I have myself found that half a dozen ducks together lay far more eggs in comparison with flocks of a much greater number, and more particularly does this apply to Indian Runners.

Size and Height of Pen.

A pen of 40 x 20 feet, if properly looked after, is sufficient for 25 ducks, and the height of the wire should be 3 feet. Of one thing I am sure, and that is, that the ordinary mesh is an absolute danger. I have found during my travels, many cases where Runner ducks have been lost by getting their heads through narrow mesh, and not being able to extricate themselves. Three inch mesh is much the safer. It is not costly, in



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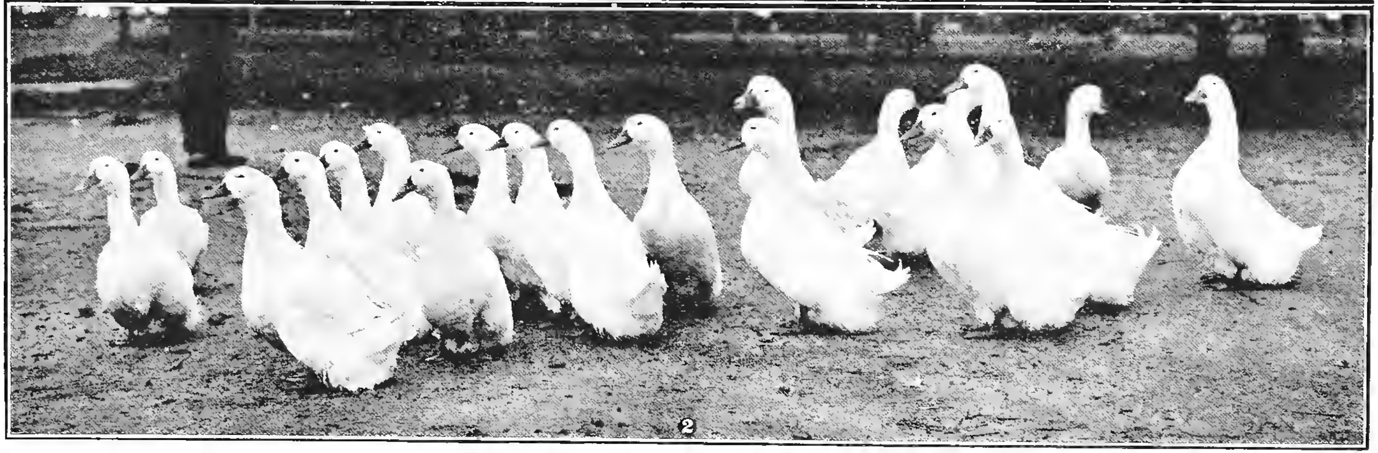

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1. Mammoth Aylesburys; the perfection of type and colour.

2. Huge Pekins, under 10 months old; 3 distinct strains.

fact duck pens can be made at very small cost as compared with pens for Leghorns, which fly so much. Ducks give little or no trouble in this respect, and are much more contented in confinement than fowls are.

Water.

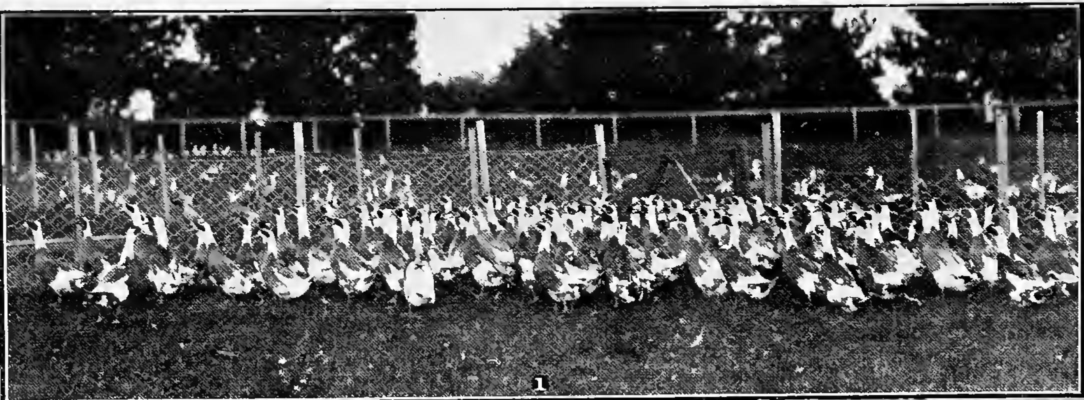
To my mind ducks that are kept for egg production should not be allowed free access to creek or dam, the more they drink the less good the food does. We want eggs or flesh, and if the birds are constantly swimming, the food passes through them too rapidly, with the result that little goes into flesh or eggs. But it must not be thought, for one moment, that ducks only require a drink once or twice daily. Clean water should always be kept in a shady spot, and the drinking vessel should be sufficiently deep to enable the ducks to wash out the eyes. It should be 7 to 8 inches deep, sufficient for them to dip their heads well in—a shallow receptacle is useless. Coarse sand should be put in the water; they enjoy it, and it is good for them.

Grit.

Smashed oyster shell, and pieces of broken up mortar (often found after the removal of an old chimney) are the best forms of grit, and it assists them in the making of the egg shell. Ducks consume much more grit than fowls, and they prefer the old mortar to anything else. The formation of the duck's body is so very different to a fowl's, for whilst the latter has two stomachs, the duck has practically only one, and coarse sand and old mortar are sufficient for the duck's requirements.

Ducks' Eggs.

The first five eggs should be used for eating purposes, as they are usually infertile, after which reserve for the broody hen or incubator. On no account part with the early eggs, if you desire to work up a flock, both for size and constitution, for by disposing of the first batch you are losing the very best ducklings. The successful breeder of ducks usually retains the first dozen from each duck, and all the champions seen at our Poultry Shows come from the early eggs. This also applies to fowls. The longer a duck lays the weaker becomes the germ, hence the necessity of hatching early for best results. July, August, and September are the best months in this State. For example, the first batch of Aylesbury eggs laid by four ducks (which number of ducks is quite enough with one drake in a breeding pen—otherwise the result will be infertile eggs)—on Mr. Briggs' farm last season, was kept and incubated, the result being that the ducklings at seven weeks weighed on the average 5¾ lbs. each—a splendid result. (See illustration). Later batches at same age did not reach 4½ lbs. each. Thus we find that by reserving the early eggs in season, we are usually the gainers. Many a young fancier, having purchased at a fair cost a quintet of ducks, and having been anxious for a quick return, has sold a few dozen of the early eggs to his neighbours. A few months pass—and he and his neighbour meet at a show. The young fancier is struck with the size of certain exhibits, and on inquiry finds they have come from the eggs he sold. This is a keen disappointment. When the farmer is anxious to breed a large number of ducklings from the one pen, a good plan is to change the drake, resting alternately. This would to a large extent keep up the size of the duckling all through the season.



1. 200 Indian Runner Ducks. 2. A pair of imported Toulouse Geese for this year's breeding purposes. 3. Rouen Ducks recently imported for stud purposes.

Utility Ducks.

Much has been written of the various breeds, and perhaps too much said with regard to their origin. The farmer cares little whether Pekins come from Japan or China. It is sufficient for him to know about the duck which will suit his requirements, be it for eggs or export. Again, what purpose shall I serve if I waste the farmers' time in wading through numerous pages, giving the points of a duck from an exhibition point of view?

AYLESBURY DUCKLINGS AND PORTABLE SHELTER SHED.

Best Export Ducks.

Select four Pekin ducks, second season preferred, and an Aylesbury drake nine months old, not younger. Have these penned up, and give them your best attention. They should be mated early in June. July, August, and September are usually the best months for laying, and the eggs are most fertile. They should have a swim for 20 minutes each morning and evening during breeding time. Where there is no natural creek, an iron tank cut in half and let into the ground will be sufficiently large for them. Have a plug and an outlet pipe, and cleanse twice weekly. Take care to have a sloping foot-board, nailing pieces crossways, to prevent them slipping, as, when getting into a tank, ducks often slip and injure themselves. Eggs are more fertile when ducks have access to water. Of course this only applies to the breeding-pen—it is not so for fattening purposes. This cross—the Pekin and Aylesbury—will produce beautiful white flesh, and plenty of it.

How to Feed the Breeding Ducks.

The food should be of good quality and highly nitrogenous. Take one part pollard, one part barley-meal, one part bran, and 15 per cent. of green food chopped finely, such as green chaffed maize, lettuce, and twice a week chopped up raw onions. Chickweed is also excellent. Cabbage is not recommended. Add also 15 per cent. of animal food, *i.e.*, boiled liver, rabbit, or beef scraps, and care must be taken that the meat is properly minced. In mixing this mash, use the soup in which the meat has been boiled, and mix up together to a nice stiffness. A little sand and ground oyster shell added to the meal is an advantage, and will prevent soft shells. The less moisture there is in the food the better for ducks; they will wet it quite soon enough, as they must always have fresh drinking water by them. Occasionally give at night a little grain, but not more than three times a week, and then alternately. Many duck breeders prefer giving soft food only.

Changing the Meal.

It is not advisable to make drastic changes in their diet. I have known instances where pea-meal and bran had been given with bad results to a flock that had been accustomed to having pollard, bran, potatoes, &c. The safest change of food, to my mind, is that of two parts maize flour, one part rice meal, and one part bran, with the vegetables and meat, added as before. It must not be overlooked that ducks in a breeding-pen must have double the quantity of animal food that fowls require. Ducks are naturally insectivorous. They haunt creeks, working through the mud, seeking water insects, worms, &c.

Rouen and Pekin Ducks.

The Rouen duck is perhaps the most perfectly marked duck in existence, and makes a suitable cross with the Pekin for market purposes. It has rather a stronger flavour than that of the Aylesbury-Pekin cross, and matures nearly as fast. It may be compared with the Game-Dorking cross. I have seen and weighed Rouens in the yards of Mr. Gaylor (to whom I am indebted for the accompanying illustration) that at eleven weeks of age scaled 5 to 6 lbs. When crossed with Pekin, they mature earlier and lay better.

Breeding the Pure Stock.

I am a great believer in the Aylesbury, and have had, with Mr. A. Lucas, late of McKinnon, ample opportunities of testing them against the Pekins. We always found they did well with us, and were very easy to rear. We were convinced that they soon lost size, and there was a diminished egg supply, when too closely bred. The Australian States owe much to Mr. P. Briggs, who has practically laid the foundation of mammoth Aylesburys, as we see them now in Australia. He has imported from time to time hundreds of pounds worth of new blood, thus enabling the farmer to secure large drakes, thereby improving the size and quality of the stock.

Indian Runners.

Whilst recognising the value of Aylesbury and Pekin as the best all-round purpose ducks, yet for egg production the Runners have the prior claim. I have known them to lay 200 eggs and more per annum, and I am informed by Messrs. Wall, Gaylor, and Henley that they have had an average yield of 219 to 230 eggs in twelve months.

Inbreeding.

If we continue to breed in, as is the case in many of the States, the Runner will be found to be a disappointing duck to keep. I have had opportunities travelling throughout the length and breadth of this State of observing the rise and fall, so to speak, of this breed, and have come in contact with many duck-farmers, and I regret that during the last twelve months fully 23 per cent. of Runner ducks hatched last season died through no other cause than this breeding in. I have in many instances recommended that until such times as new blood can be obtained, the crossing of Runners and Rouens—not for the added size, but for the greater stamina given to the ducklings. This cross produces a nicely-marked bird, and a very much better layer than some people suppose, and, what is better, the farmers will get better prices for the surplus drakes of this cross than they can ever expect with Runner drakes, which are not fit for market purposes.

Incubating.

When hatching ducks in a large way the artificial means (incubators) should be resorted to, as it is almost useless to attempt to use the duck, and broody hens are difficult to secure at the correct time. Duck eggs will not keep so long as hen's; being more porous, they get stale quicker. The best and by far the most profitable way is to use the incubators. This should be of the celebrated English (Hearson's) pattern, having the tank. The hot-air machines are not the success that the tank machines are, especially with duck eggs. I have known many failures in this State where the hot-air machines, lacking a moisture tray, have been used.

TEMPERATURE FOR DUCK EGGS.

Duck eggs require a little less heat than hen eggs—102½ deg. is about the right temperature. They also need more moisture as hatching time approaches, but not before. The moisture tray should be placed in machine seven clear days prior to hatching—*i.e.*, after twenty-one days—twenty-eight days being required for most breeds of ducks, though Muscovies take usually five weeks. It is absolutely necessary to turn the eggs at least twice daily, and the cooling of the egg-drawer is beneficial to the embryo. The last seven days the egg-drawer should be cooled daily for at least fifteen minutes—many successful breeders cool them up to thirty minutes—but when the eggs are chipping the egg drawer should be left alone, and not interfered with, except to turn the chipping side up. Never sprinkle the eggs.

HOT-AIR MACHINES WITHOUT MOISTURE A FAILURE.

On several occasions I have visited farmers who have used hot-air machines for duck eggs, and have invariably found them sadly disappointed, the trouble being that the ducklings were dead in the shells. On opening them I have found a too large vesicle, and the membranous tissues quite dry, like parchment, instead of the soft membrane seen when moisture is present.

AN AMERICAN EXPERIMENT.

In a report of the Biological Division at a leading experimental station appears the following dealing with the moisture question :—" An attempt has been made from the beginning of last year's experiments with hot-air machines to render the moisture factor as uniform as possible. To effect this the concrete floor of the basement has been constantly *kept wet.* A constant supply of water was thus exposed to the atmosphere of the room. The air was much improved by this constant wetting in so far as its respirability is concerned." This being so, surely it is folly to attempt duck-raising with hot-air machines without the moisture-tray in Victoria, where the atmospheric conditions are much drier than in America. I must again repeat that the Victorian-made tank machines are more than equal to any imported foreign makes, and this is especially so in regard to duck eggs. Further proof is given from New South Wales, where six machines were tested, two of local make and four imported, the results being—Australian, first and second; and American, last. Further, Mr. Digby, of England, a leading duck breeder, favours the tank machine as made by Hearson (England), as it is so perfectly ventilated, allowing, as it does, the interchange of gases.

SETTING DUCK EGGS UNDER HENS.

Do not put too much straw or any excessive nesting in nest for duck eggs—the less the better. The best results I have obtained have been when the nest was on the ground; in fact, damp at that. Avoid placing duck eggs in a room or in a box when using a hen in a dry atmosphere. If moisture is neglected, the lining membranes will become like parchment, and will in many cases stick to and dry on to the young mites not yet out of shell, and the result is they die in the shell.

DRY NESTS.

If nest appears too dry, and the hen neglects to dust herself in a cool spot, slightly damp the outside of nest. I have known the nest to be flooded by heavy rain, and have seen duck eggs partially under water, and yet hatch nine out of eleven set, all of which reared successfully.

HATCHING DUCKLINGS.

When hatched, the young should be left under the hen until thoroughly dry and strong enough to stand. Many are lost through being removed too early from the nest. In a few days, three or more broods may be put together under one hen. She is quite able to take care of them. Never allow them access to creek or pond, but keep fresh water by them for drinking purposes. Put a little sand in drinking vessel. They require no food for quite twenty-four hours, but a little water will do them good.

FIRST FEW DAYS' MEAL.

This should consist of hard-boiled egg mixed with a little boiled rice and liver cut up very small, and should be given several times daily. Occasionally change the rice to oatmeal. When ten days old, give barley-meal one part, pollard one part, and a good portion of fine meat scraps and raw onion. A little dry bone-meal is beneficial, and assists to build up their frame. Onion-tops are an excellent green food, mixed in mash. Coarse sand must be added to water, otherwise digestive disorders will follow. Then feed largely on barley-meal, a little bran, with plenty of skim-milk, liver, and maize chaff, occasionally adding finely chopped raw onion or tops. The last fourteen days they should not have any grass, as grass discolours the flesh.

General Reminders.

(1) Don't attempt to catch the ducks by their legs. It is much safer to handle them by the neck.

(2) Don't reduce their weight by taking a lamp amongst them at night.

(3) Never throw dry lime in a duck pen; it kills.

(4) Never select the largest duck eggs for hatching; they are usually infertile.

(5) Never set a hen on duck eggs in a dry shed unless you moisten the nest twice weekly.

(6) Always provide plenty of carbonate and phosphate of lime to assist shell-making. This is found in oyster shell.

(7) Keep plenty of coarse sand, old mortar, and a little charcoal in a box for laying ducks.

(8) Keep ducks away from creek at night-time, otherwise you will lose many eggs.

(9) Ducks should always be locked in at night, and kept on an absolutely dry, soft floor. They lay best, and the eggs are easily gathered.

(10) To breed the most healthy ducklings, avoid the heavy, *fattened* show birds which lay but few eggs, and those are usually infertile. Show ducks are almost useless to breed from. It spoils them for that purpose.

(11) Never hurry the laying ducks. It usually injures them; sometimes seriously. When handling ducks, never hold them by the wing.

(12) When sickness attacks ducks, it is useless to doctor. The best remedy for duck ailments is the "Lily Bulb of the Kitchen"—plenty of sliced raw *onion* in the mash, and an absolutely dry, soft bed.

(13) When you desire Runner ducks for egg production, have four to five ducks with an unrelated drake; two ducks and one drake usually produce too large a percentage of drakes, and they don't pay to fatten.

(14) July, August, and not later than the middle of September is the best time to secure the strong embryo germ.

(15) Feed well your market ducks; let them have their fill—up to ten weeks. They pay best when fattened before they commence to shed the young feather.

(16) When giving grain, it is best scalded or placed in the water vessel. The safest time for grain meal is midday, and then not more than three times weekly.

(17) It costs 2½d. for each 1 lb. of duck flesh.

(18) Ducks should never be permitted to run with fowls. They both do best in pens by themselves.

(19) When fowls and ducks are allowed to drink from the same vessel, look out for disease.

EXPORT POULTRY.

The indications of a general improvement in all matters pertaining to the poultry industry are distinctly noticeable, and the export trade, in common with the other branches, should receive consideration from the poultry keeper. There is plenty of scope for the improvement and development of the trade, and the British and South African markets are open to receive an almost unlimited quantity of well fattened birds of fair weight and correct age.

Benefit of Export.

By present appearances poultry keeping is likely to be conducted on extensive lines in our State, and it is very probable that the quantity reared will be in excess of what is required for local consumption. The oversupply must affect the price of poultry to a great extent, and the profits will be decreased thereby, but the institution of an export trade in table poultry to outside markets should provide a remedy. Besides providing a source of revenue derived from the outside countries, it will also tend to keep up the price of poultry in our local markets. We are at present shipping wheat and other grain to Great Britain, and there is no reason why we should not send a good portion of it in a concentrated form in the shape of frozen poultry. This would not only lessen the freight to the producer, but should result in an increased return to our State. The shippers of poultry are now open to take any number of suitable birds. The price that they paid at the beginning of the season was 6d. per lb. live weight, but as the London market is now easier, they are offering from 5d. 5½d. for stock of good quality, and carrying the Government stamp. This is an inducement to the producer to fatten his poultry as they are sold by weight. It is also a benefit to the industry by opening up an outside market for the poultry produced in Victoria.

DIAMOND JUBILEE ORPINGTONS, 4 MONTHS OLD.

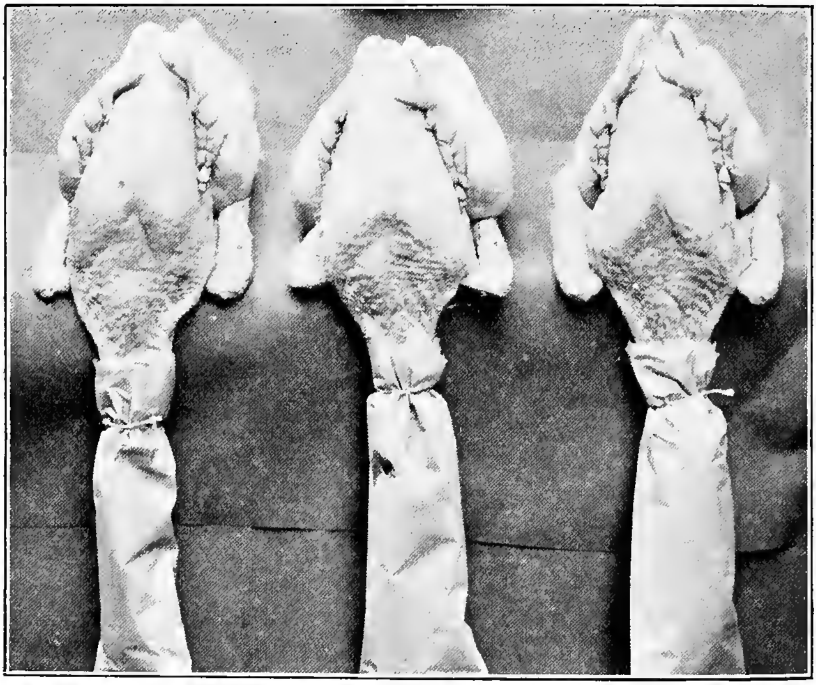
Suitable Breeds.

The main point in rearing poultry suitable for export is to make a start on correct lines, and the choice of a suitable breed or a combination of breeds is required. The pure varieties recommended are Buff Orpingtons, Diamond Jubilee Orpingtons, Faverolles, Silver and White Wyandottes.

A very suitable cross will be produced by mating a Dorking cock with any of the above breeds. Black Orpingtons and Plymouth Rocks may also be mated with a Dorking cock, as these birds will throw the majority of stock with the much fancied white shanks and feet. The crossing of two pure breeds will also render the stock very hardy. Amongst the consignments of poultry coming in to our regular markets, there are a considerable number of pure bred birds of the abovementioned varieties, and top prices have been realized for good-conditioned lots. The white shanks and feet are items that must not be overlooked in export poultry, as these are very important points in the British market.

Time for Export.

The best time for exporting so as to command highest figures for poultry is to land them in England from March to June. If the birds are ready, they may be killed at any time, and kept in the cool chambers until they are required to be shipped. Chickens should be from $3\frac{1}{2}$—$4\frac{1}{2}$ lbs. live weight, and their age should be from 14-18 weeks.



FOWLS DRESSED FOR EXPORT.

Fattening.

All birds intended for shipment should be topped off for a month previous to being killed. This may be done by natural feeding or the use of the crammer. By the aid of the latter the breeder can force his birds on quickly. It is only to be recommended where poultry are kept on a large scale, and I would advise natural feeding as the safest method. The food given should consist of ground oats, pollard, barley meal, or maize meal, scalded with separated milk, and placed in V-shaped troughs. A liberal supply should be given three times a day, and plenty of grit and green food may be given. Cockerels and pullets should be kept separate, and be enclosed in coops which will hold six chickens. A suitable size is 3 feet long, 18 inches wide, 20 inches high. The front is made of laths, and the trough is fixed on the outside of the front of the coup. During the last fourteen days, rendered mutton suet or green-cut bone should be mixed with the food each day, the proportion given being 1 lb. of either to 20 birds. In sending consignments of poultry to the shippers, they should be properly graded, and as near a uniform size and weight as practicable. The condition of a bird is also a matter which requires close attention, and no inferior birds should be sent. Farmers in the past have suffered to a great extent by sending poultry in poor condition. This always causes a glut on the market, and such consignments bring only about half the price that good-conditioned birds would realize. The necessity of feeding is quite as important as that of breeding, and it is on the former that the success of the export trade depends.

The extent of the demand for poultry and eggs in Great Britain can be estimated by the fact that during the past year the importation of these products reached a total of £7,819,618. This enormous supply is principally derived from Russia, Denmark, France, Germany, Belgium, and Canada. It is estimated that the value of eggs and poultry consumed in Great Britain was £17,669,618 for last year. With such an enormous demand there is no possibility of a glut, and there is ample room for the disposal of our surplus stocks of both products. The cost of production and freight, and other incidental charges in connexion with exporting, should leave a good margin of profit to the producer, providing that the shipments are of tip-top quality, and arrive home when highest market prices can be obtained.

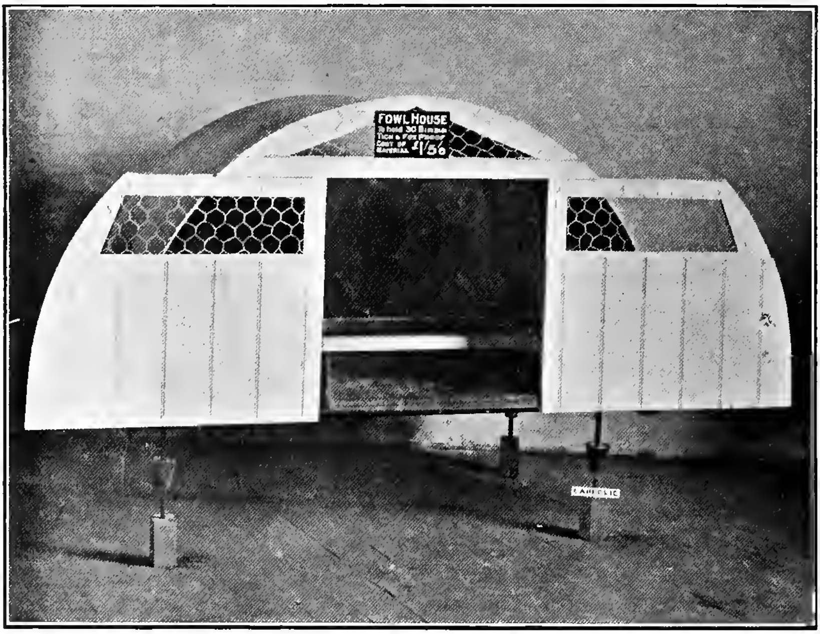
PREVENTION AND ERADICATION OF TICK.

Although the efforts of the Department during the past few years in dealing with and eradicating the tick have met with considerable success, it has not been altogether stamped out. The difficulty of dealing with the many and varied resorts of these pests has rendered the process very difficult, and the presence of trees in the poultry yards proves a veritable harbor for the tick. Several methods have been tried, and the effects of carbolic acid sprayed on the infected portions of wood and other materials have been particularly successful. One of the best methods for prevention of tick is the erection of a fowl-house which will prevent these pests from reaching the fowls.

The accompanying illustration depicts an ideal tick and fox-proof house constructed on the latest improved lines. It is built of iron and wood, the materials being as follow:

Two 10-ft. sheets of corrugated iron turned half round.
120 ft. flooring and lining boards.
2 yards wire netting.
4 iron rods with soldered cups, 18 inches long, ¾ inches in diameter.
3 perches 2 x 2 in. hardwood let into two flooring boards placed on edge.

The door is made in two sections fitted into slots at top and bottom, so that they can slide as required. The iron comes down 2 inches below the level of the floor, and rests on two pieces of 3 in. x 2 in. H.W.; a batten 2 in. x 1 in. is then nailed on the outer edge of the rests, and a similar one on the inner edge. This carries the floor, and makes a suitable groove to carry the iron, which should be bolted. The floor and other portions of woodwork should receive a coating of hot tar, which will fill up all cracks or crevices, and also preserve the wood. The iron rods are let into blocks resting on the ground. These rods are placed about 8 inches from the outer edge of the house, so that the weather will not affect the liquid in the cups. The tops of the rods are let into 2-inch holes in the frame of the house. This house will hold 25 full grown or 30 young fowls, and the cost of the whole should not exceed 25s. It should be placed in a shady spot, and kept well away from fences or hedges, &c.



TICK AND FOX PROOF FOWL HOUSE.

CALENDAR FOR FARM, ORCHARD, FLOWER, AND VEGETABLE GARDEN.

Adapted for places in Victoria about the latitude of Melbourne. The northern and more southerly districts will be a little earlier and later respectively.

JANUARY.

FARM.—Finish cutting barley, oats, and wheat. Pull late sown crops of peas. Stack all grain as soon as fit, especially malting barley, which should never be threshed out of field. Keep horse hoe at work among potatoes, mangolds, and other root crops.

ORCHARD.—Keep the surface loose and free of weeds, by scarifying or other method of light cultivation. After irrigation or rain, cultivate as the soil is drying. Spray with one of the arsenical washes, such as Paris green or arsenite of soda, against codlin moth, more particularly in districts where a second brood occurs. Examine and cleanse bandages on apple and pear trees at least every ten days. Spray with the same solution against pear slug, and vine and other caterpillars. Remove surplus shoots from young trees, and shorten back strong laterals.

FLOWER GARDEN.—Cultivate, mulch, and water, to keep the soil cool and moist. Shade tender plants, especially such as are not established. Tie shoots of dahlias, chrysanthemums, &c., to stakes as growth advances. Plant bulbs of gladioli. Sow seeds of pansy and Iceland poppy in boxes in sheltered situations, for transplanting, also seeds of various perennial and biennial plants.

VEGETABLE GARDEN.—Plant out from former sowings of cabbage, cauliflower, celery, &c., and sow seed for succession. Plant out early potatoes for autumn crop, and prepare ground for reception of future crops.

FEBRUARY.

FARM.—As soon as threshing is over, put the cultivator on stubble land. Harrow and burn off all refuse. Cart out, spread and plough in manure on potato land for fallow. Dress all seed grains ready for sowing. Rape and swedes may be sown, and if rain falls, the first sowings may be made of barley, rape, and vetches for green fodder.

ORCHARD.—Continue to cultivate surface and water citrus trees. Spray twice, early and late in the month, against second brood of codlin moth, and cleanse bandages regularly. Gather and boil affected fruit. Thin out young trees, but do not top main shoots. Gather, grade, and pack for market or export various fruits as they mature. Allow fruit that is to be exported to remain in shed two or three days before packing, to allow skin moisture to evaporate.

FLOWER GARDEN.—Keep the surface well cultivated, and water thoroughly during hot weather, attending especially to the wants of young and surface rooting plants. Thin weak wood from roses, and water liberally to induce free growth for autumn blooming. Save the crown buds on chrysanthemums after the first week or ten days. Thin out and disbud dahlias. Plant bulbs and roots of tulips, ranunculus, &c. Prepare ground for daffodils, and other plants.

VEGETABLE GARDEN.—Continue to plant out cabbage, cauliflower, and celery, and sow seed of turnip, cabbage, lettuce, early peas, French beans, &c., and to prepare land by manuring and digging as it becomes vacant.

MARCH.

FARM.—Plough fallow for potato and early hay crops. Sow barley, rye, and vetches for green fodder. Dig early potatoes. Prepare land for lucerne and grasses. Improve unprofitable patches by removing stumps and rocks, draining, top dressing, &c., as the case may be.

ORCHARD.—Prepare land for planting trees. Plough as deeply as possible, leaving the surface rough. Drain thoroughly and systematically. In moist weather plant out strawberry plants. Continue to destroy "grubby" fruit and to cleanse bandages.

FLOWER GARDEN.—Cultivate and water during dry weather. Plant out evergreen trees, shrubs, &c., from pots, and bulbs of Narcissi and other spring blooming bulbous plants. Sow seeds of hardy annuals. Apply liquid manure to roses, dahlias, and chrysanthemums. Destroy aphis, red spider, and mildew.

VEGETABLE GARDEN.—Continue to plant out from former sowings of various vegetables required. Sow seeds of cabbage, cauliflower, lettuce, early varieties of peas, Swede turnip, onion, &c., and prepare land for future use.

APRIL.

FARM.—Plough land for main crop of cereals. Sow wheat and oats. Dig potatoes as they mature. Plant lucerne, clovers, and grasses as early as weather will permit.

ORCHARD.—Proceed with the preparation of land for planting trees, and plant out strawberries. As the apple and pear crops are gathered, remove all bands from trees, and either boil or burn them. Store only fruit of medium size and good quality, that has been carefully gathered before ripening, and keep from draught, or it will shrivel.

FLOWER GARDEN.—Continue to plant evergreen shrubs and trees from pots; also divisions of spring-blooming herbaceous plants, and pansies and other plants raised from seeds, cuttings, or layers, during summer. Feed chrysanthemums for exhibition with liquid manure weekly, until the flowers begin to open. Prepare land for the reception of roses, deciduous trees, and shrubs, &c.

VEGETABLE GARDEN.—Plant out from former sowings of cabbage and cauliflower, changing and rotating as much as possible. Sow more seed of onions for transplanting, also early peas and broad beans for spring use.

MAY.

FARM.—Dig main crop of potatoes. Push on with ploughing and sowing of cereal crops, including peas and beans. Oats and barley, with peas or vetches, may still be sown for green fodder. Land for maize, potatoes, mangolds, and other root crops should be manured and prepared. Flax may be sown.

ORCHARD.—Apply manures, plough down weeds, and sow field peas for green manure. Plant small fruits, as currants and gooseberries, as soon as leaves fall. Begin the work of ploughing. pruning, &c. Drain if necessary. Spray trees infested by scale insects or woolly blight with oil emulsions, preferably "red oil," or "crude petroleum." Remove rough bark from stems and branches of old trees, and destroy insects harbouring there.

FLOWER GARDEN.—Begin the work of digging, manuring, and pruning. Bury all herbaceous stems, leaves, annual weeds, and even light branches. Continue the planting of spring-blooming perennial and other plants. Insert cuttings of roses, carnations, &c. Lift and store dahlias as the tops wither, and begin the preparation of beds for special subjects, as dahlias, chrysanthemums, &c.

VEGETABLE GARDEN.—Cut down tops of asparagus and work manure into the beds. Plant out cabbages, &c., also potatoes (early varieties) in warm situations, and sow seed of carrots, parsnips, beans, peas, for succession. Manure and work land deeply for sowing and planting vegetables for summer use.

JUNE.

FARM.—Plough potato land. Sow malting barley during wet weather. Clean up all manure, and heap it ready for next season. Clean out all drains and water furrows. Finish sowing of oats and cereals. Lift and store mangolds, turnips, &c. Prepare land for summer crops.

ORCHARD.—Plant fruit trees in well-prepared land. Any roots damaged should be cut back to sound growth. Shorten and balance long straight roots of unequal size. Prune fruit trees generally, beginning with the weakly and oldest trees. Continue spraying against scale and blight. Plough deeply and away from trees, and with fall (except in very steep situations) to allow excessive moisture to drain away. Clear all surface drains, and in low, wet situations open drains temporarily.

FLOWER GARDEN.—Plant deciduous trees and shrubs. Divide stools of chrysanthemums and plant suckers of moderate size in unmanured soil to remain until spring. Continue pruning, manuring, and digging. Sow seed of sweet peas and plant out annual and perennial plants raised in autumn.

VEGETABLE GARDEN.—Plant out onions, rhubarb, and horse radish, and sow seed of peas, beans, onions. cabbage, &c.

JULY.

FARM.—Finish sowing barley, peas, beans, and other crops. Gather all manure. Plough for potato fallow. Keep all drains and water-courses open. Trim hedges. Continue to work the land for maize and other summer crops. Graze off the cereal crops with sheep, if far enough advanced.

ORCHARD.—Continue the planting of fruit trees, including small bush fruits, as currants, raspberries, &c. Prune newly-planted trees, cutting back to 2 or 3 inches from stem, and allowing three shoots only to remain, of as near as possible equal size, and at equal angle from stem. Proceed with ploughing, digging, and pruning.

FLOWER GARDEN.—Prune roses, excepting banksian and other climbing kinds of a similar character. Continue to plant deciduous trees, shrubs, and climbing plants; also divisions of herbaceous plants, and annuals. Protect plants against snails, &c., by occasional dustings of lime or soot. Plant Liliums, Gladioli, Tigridias, Vallotas, and other summer blooming bulbous plants.

VEGETABLE GARDEN.—Sow seeds of onions, broad beans, peas, carrots, parsnips, early cabbages, and cauliflowers, and plant another "batch" of early potatoes in a warm situation.

AUGUST.

FARM.—Give second ploughing to potato fallow. When the weather permits, roll and harrow crops. In early districts plant early potatoes, and begin to sow lucerne, maize, and summer crops as the danger of frost passes. Main sowings of mangolds should be made.

ORCHARD.—Finish planting and pruning deciduous trees. Plant citrus; prune closely, and mulch. Hoe between and mulch strawberries. Spray against mussel scale and woolly aphis with oil emulsions; also against black aphis on peach trees, using strong tobacco wash.

FLOWER GARDEN.—Complete digging as early as possible. Divide and replant Delphiniums, herbaceous Pæonies, perennial Phlox, &c. Plant Tuberose, Richardia, &c. also another set of Gladioli. Sow seed of hardy annuals. Mulch newly-planted roses, shrubs, &c.

VEGETABLE GARDEN.—Plant out asparagus, cabbage, cauliflower, and onion, also divisions of herbs and early potatoes. Sow seed of tomato, melon, and other plants that are susceptible to frost in hot-bed frame; also seed of various vegetables and salads for summer use.

SEPTEMBER.

FARM.—Plant early potatoes and work up fallow for main crop. Top dress backward crops with nitrate of soda or sulphate of ammonia (½ to 1 cwt. to the acre). Make early sowings of mangolds, beet, field carrots, and turnips. Push on with the fallowing for wheat in northern districts.

ORCHARD.—Plough before the soil becomes dry and hard, throwing the soil to the trees. Unsuitable varieties may be cut back and regrafted. Spray peach and apricot trees with Bordeaux mixture as the blossom buds are opening, as a preventive against "leaf-curl" and "shot-hole" fungi.

FLOWER GARDEN.—Cultivate extensively to bring the surface to a condition of fine tilth and to keep weeds in check. In dry weather water plants newly set out, especially such as have their roots near the surface. Thin and regulate growing shoots on roses and various shrubs. Plant out cannas, dahlias (for early blooming), chrysanthemums (for massing and border decoration), and other herbaceous plants.

VEGETABLE GARDEN.—Sow seeds of vegetables required for summer use, and plant out from former sowings. Sow tomatoes, chilies, cucumbers, marrows, pumpkins, melons, &c. A few may be planted out from frames and sheltered till danger of frosts is over.

OCTOBER.

FARM.—Plant potatoes. Sow mangolds, beet, field carrots, and turnips. Sow maize, millet, &c., for summer fodder and ensilage. Keep the cultivation going between the rows.

ORCHARD.—Continue ploughing and cultivating. Aim to produce a finely pulverized surface, free from weeds. Spray against "black spot" of apple and pear, using Bordeaux mixture. Apply as the flower buds are opening. Spray carefully with arsenical washes against codlin moth in early districts, such as Bendigo, Wimmera, &c. Apply as soon as the fruit has set. Place bands of stout bagging *tightly* on apple and pear trees (thin and loose bands are useless), for the purpose of trapping the larvæ of the codlin moth. Continue to spray against peach aphis, using strong tobacco and soap wash, which is also the safest and most effective wash against woolly aphis at this season.

FLOWER GARDEN.—Keep the hoe going; *prevent* weeds, if possible. In doing so the soil is being sweetened, and moisture conserved. Plant out chrysanthemums in special beds, also another batch of dahlias if required to bloom about January. Dig and liberally manure beds for dahlias to be planted in December for autumn blooming. Plant out summer bedding plants; replace annuals that have bloomed, and sow seeds of annuals. Keep roses free from aphis and mildew.

VEGETABLE GARDEN.—Sow seeds of French bean, tomato, celery, cabbage, marrow, and others of the same family; and plant out from former sowings. Plant out tomatoes that were raised on hot-bed, and shelter from frost while necessary.

NOVEMBER.

FARM.—Finish planting main crop of potatoes. Cut hay and stack as soon as fit. Make ensilage of barley and peas, oats, and self-sown grasses, thistles, &c. Keep harrows going on potato land. Horse hoe any too advanced for harrowing. Finish planting maize, millet, sorghum, and summer crops.

ORCHARD.—Continue to plough lightly, to harrow and scarify, to keep the surface loose and free of weeds. Examine young trees and remove shoots that are unnecessary or misplaced. Secure grafts against wind. Spray against codlin moth twice during month at intervals of about fourteen days. Spray against pear slug, using Paris green or other arsenite. Apply as soon as insects are noticed. Avoid spraying ripening cherries with arsenite; use hellebore. Continue to spray peaches, &c., infected by aphis.

FLOWER GARDEN.—Cultivate, and water when necessary. Prune weakly wood from roses and deciduous shrubs after blooming period. Lift and store spring flowering bulbs, as hyacinths, tulips, &c., after tops have withered. Secure to stakes or support climbing and other plants as growth advances. Thin chrysanthemums intended for large blooms.

VEGETABLE GARDEN.—Prepare ground from which early crops have been harvested for future cropping. Sow seeds of French bean, late varieties of pea, lettuce, &c., in cool and moist situations. Stake tomatoes, and remove laterals as they appear.

DECEMBER.

FARM.—Finish cutting hay. Cut oats and early crops of barley. Keep horse hoe going among potatoes. Plough or burn fire breaks as soon as the grass is dry.

ORCHARD.—Maintain a clean, light, friable surface. Spray against codlin moth every fourteen days. Remove all bandages and destroy all grubs by boiling, &c. In hot northern districts weekly examination is necessary at this season. Carefully examine any grubs secreted in bark under bandages. Spray against pear slug in southern districts.

FLOWER GARDEN.—Plant out dahlias for autumn blooming. In early districts plant late in the month; late, *vice versâ*. Layer carnations, also daphnes, camellias, and other plants that do not "strike" readily from cuttings. Attend to watering, staking, tying, and training.

VEGETABLE GARDEN.—Sow seeds of autumn and winter varieties of cabbage and cauliflower, Brussels sprouts, celery, &c., for transplanting later for winter use. Plant out from former sowings of cabbage and celery.

WASTE WATER USED FOR IRRIGATION.

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